the OIL AND GAS JOURNAL

MARCH 19, 1956

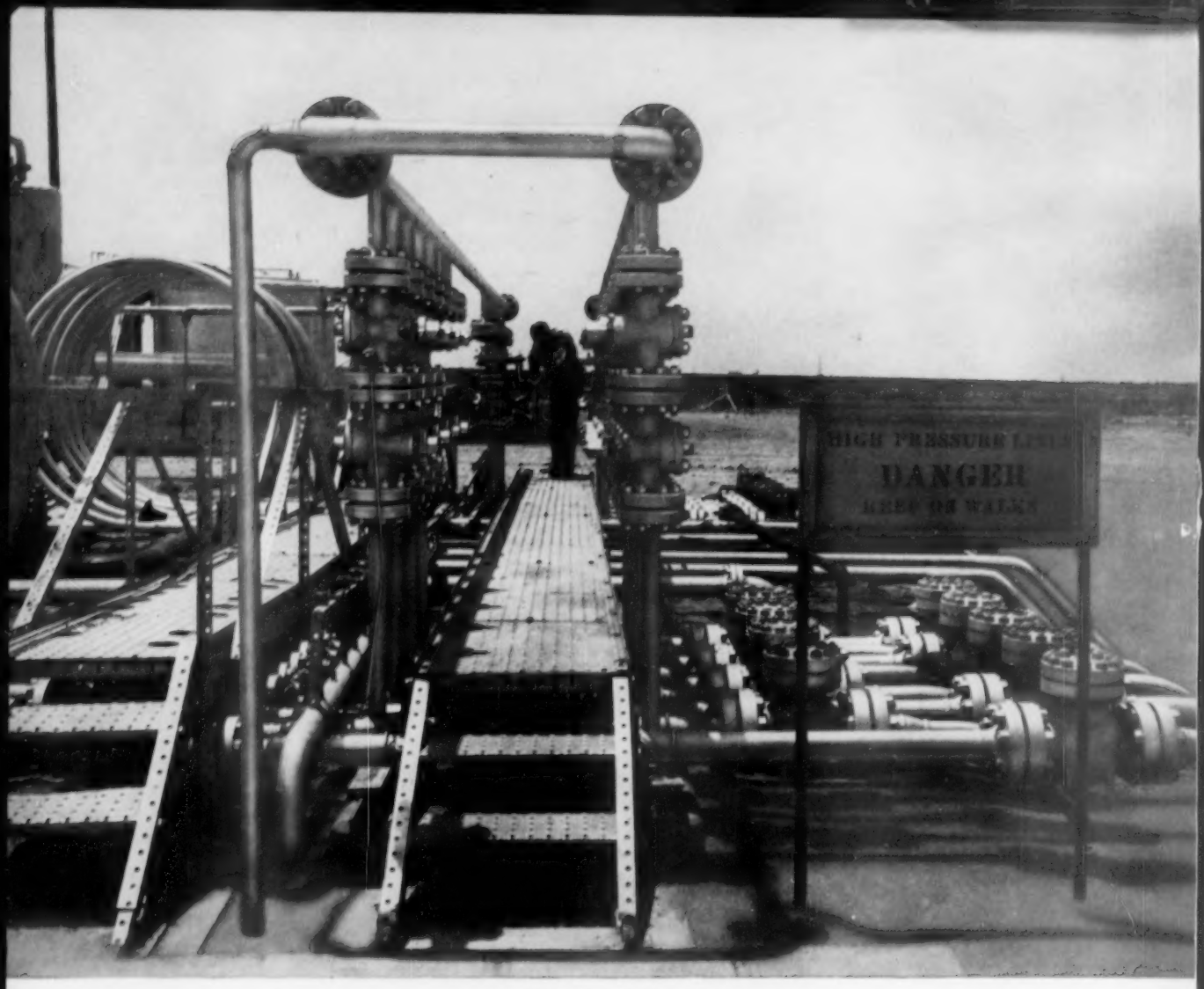
ANNUAL Refining NUMBER

- **42 Processes for 100 OCTANE**
  . . . Special section. *Starts p. 137*

- **Refining in '56**
  5% increase in basic capacity
  More building to improve quality. *p. 114*

- **A.P.I.—A.G.A. Reserves Figures**
  Oil gain moderate—gas soars. *p. 122*

Orders for Oil-Industry Steel Are Piling Up • p. 130



Why Did This Oil Company Insist On Rockwell-Nordstrom Valves?

The production manifold you see in the picture above is a long way from a repair shop. That's why this oil company insisted on Rockwell-Nordstrom valves. Experience has proven that Rockwell-Nordstrom valves avoid costly shut-downs in two ways. First: The exclusive Sealdport* lubrication system forms a *positive* seal against leakage. Second: The plug glides on a film of lubricant for *instant*, quarter-turn operation—even after the valve has been open or closed for months.

Rockwell-Nordstrom valves are available in a complete line designed to resist corrosion, erosion, and the high pressures so often encountered in field service. They assure utmost reliability anywhere you use them, yet they cost no more to buy, often less, than ordinary valves. For more details, see your nearest supplier or write Rockwell Manufacturing Company, Pittsburgh 8, Pa.

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ROCKWELL-Nordstrom VALVES

Lubricant Sealed for Positive Shut-off

40th YEAR *of lubricated plug valve leadership*

A Glance Ahead . . . . at press time

These trends will make TOMORROW'S NEWS

Natural gas is rapidly becoming a major political issue in Canada. Newspapers and political leaders are talking along party lines on the question of an all-Canadian pipeline vs. an exchange arrangement involving U. S. pipeline companies. Labor spokesmen currently are branding gas exports to the United States as a "give-away." Chances of early construction of any major projects are likely to hinge more and more on Canadian politics.

Look for the drilling-mud cyclone separator (Feb. 20. Page 91) to get a lot of attention in the near future.

Big interest is in how it will recover barites from weighted muds in comparison with the decanting centrifuge. Incentive is its low price, simplicity, and low maintenance. Several companies which have been lab testing the cyclone for barite recovery are now ready to field test it.

Microwave may go offshore soon to serve gulf drilling and production operations. Several companies operating off Louisiana are considering it because of poor VHF reception at long range, need for more channel space, and the desire for privacy.

Plastic tape for pipeline coating may have cracked the big-inch barrier. Polyethylene tape will be used this spring for the first time on a big, cross-country transmission line. American-Louisiana Pipe Line Co. will try it out in Tennessee. It plans to wrap 10 miles of its 30-in. line now being built.

The depletion allowance may come up for a showdown fight this session. Sen. John J. Williams of Delaware has let it be known he will propose a cut in the 27.5 per cent allowance as an amendment to any tax bill coming from the House other than the bill to extend the present 52 per cent corporate rate and emergency excise tax hikes for another year.

There is little chance that Congress will approve Interior Department plans to open up for development the Alaskan lands set aside by President Roosevelt as part of the Navy's oil reserve.

Always slow to act on matters affecting Alaska, congressional committees have sat on the proposal for a year. Many members fear that any action now would bring another charge of "give-away" in the coming campaigns.

Humble Oil & Refining Co. is reconsidering earlier plans for a 10-in. crude pipeline off the coast of Louisiana. If built, the line would carry Humble production from Block 30 field, West Delta area, which is about 8 miles from shore. Shell, California Co., and C.A.T.C. also have production in the field, rated as one of the major offshore discoveries.

Oil shale and gilsonite activities are beginning to stir. Union Oil Co. of California is under way with its $5 million oil shale experimental plant near Rifle, Colorado. Contracts have been let to Stearns-Roger Manufacturing Co. and work has been started on roads and plant structures.

American Gilsonite's pipeline from eastern Utah to the proposed refinery site at Loma, Colo., has been delayed by steel shortage, but 1956 will see new progress in construction.

The OIL AND GAS JOURNAL

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EXPLORATION • DRILLING • PRODUCTION • FIELD PROCESSING

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SPECIAL REFINING SECTION

Special Process Section: Making 100-Octane Motor Fuel **137-184**

Here are flow sheets and flow descriptions of 42 processes that are currently used for or may be adapted for production of high-octane motor fuel. There are 6 catalytic cracking processes, 13 catalytic reforming processes, 7 hydrogen-treating processes, 6 alkylation processes, and a number of others for special treating and processing purposes. Particular emphasis is given to typical operating data, yields, and economics.

How High Are Octanes Going and How Will They Get There? **186**

By George Weber

What is the limit on octanes, and what will refiners do to make them? These are perhaps the two most important questions facing refiners, and we won't know all the answers for several years at least. Right now refiners are straining to meet the expected 100-octane level on premium gasoline. Before that level is reached, however, industry will need to lay the groundwork for making even higher antiknock quality fuel. There will be no alternatives to this challenge during the next few years. The gas-turbine engine is at least that far away, and when it does arrive it probably won't entirely supplant the piston engine.

How Union Gets Top Octanes from Two California Plants **195**

By John M. Deal

One of the most challenging refinery problems in the United States is the production of a high percentage of high-octane gasoline from California's heavy crudes. Union Oil Co. of California has increased crude runs by one-third in 5 years and increased gasoline production from 38.6 per cent of the crude to 43.7 per cent. Expansion of processing facilities over this period was directed toward (1) reduction of fuel-oil production, and (2) increase in quality and quantity of gasoline. New facilities at the two plants include coking plants, catalytic cracking units, hydrogen-treating units, and catalytic reforming units. Realization per barrel of product sold increased 10 per cent during the 5 years.

Annual Survey of Capacities of Operating Refineries **213**

By LaWanda Turner

The Journal's 1956 survey of North American operating refineries shows that United States refineries boosted capacities to nearly 9,000,000 bbl. daily by January 1, 1956. Other capacities on this date are: (1) vacuum distillation, 2,392,683; (2) thermal operations, 2,355,318; (3) catalytic cracking, 3,709,332; (4) catalytic reforming, 926,469; (5) hydrogen treating, 433,005; (6) alkylation, 254,209; (7) polymerization, 141,650; (8) lubes, 186,151, and (9) asphalt, 379,390 bbl. per day. Coke capacity was 10,882 tons per day.

Survey of New Refinery Construction **248**

There will be healthy increases in crude, catalytic reforming, catalytic cracking, and hydrogen-treating capacities in United States refineries during 1956. That in a nutshell, is the result shown in our refinery construction survey. Crude throughput should go up to 9,300,000; catalytic cracking capacity to 4,000,000; catalytic reforming capacity to 1,235,000, and hydrogen treating to nearly 700,000 bbl. per day by January 1, 1957. Modest increases are also scheduled for alkylation, polymerization, lubes, coke, and asphalt.

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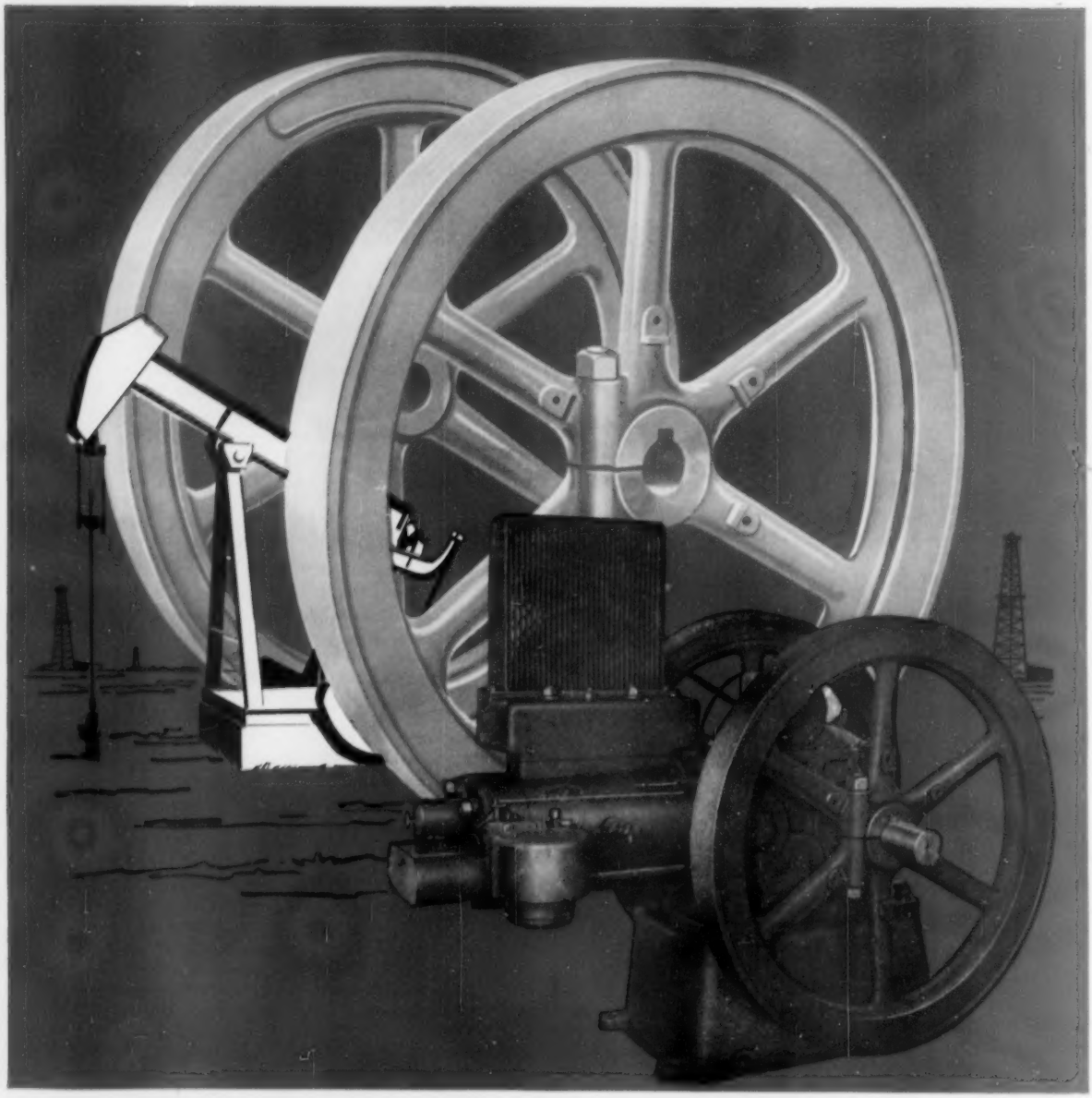

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REFINER'S GUIDE—for using Du Pont Metal Deactivator

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Motor Gasoline	Protects your high octane gasoline by preventing copper-caused gum, often a source of customer dissatisfaction. Du Pont Metal Deactivator may also provide important savings when used with other Du Pont additives.
Kerosines	DMD is useful as a color stabilizer in some copper-sweetened stocks. It has also been reported effective in reducing carbon and coke formation in pot burners by as much as 50%.
Jet Fuels	DMD has been approved by military specification (MIL-F-5624C) for use in jet fuels to inhibit deterioration, thereby decreasing fuel system plugging and residue formation.
Diesel Oils, Home Heating Oils	DMD helps prevent color deterioration, improves storage stability, inhibits formation of gelatinous sludge due to copper pickup.
Turbine Oils	The advantages vary according to service.
Greases	Displays benefits in greases for bearings which may have copper content. It is frequently used in conjunction with a Du Pont antioxidant.
Special Applications	DMD counteracts the catalytic effect of metals on gasolines during long storage periods, and this is especially important for stabilizing "driveaway" gasolines.

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The service representatives at these Du Pont laboratories will be glad to work with your staff on your own particular products and problems. Because combinations of DMD with other Du Pont additives so often bring greatly increased benefits, Du Pont technical people are especially well-equipped to help you. They may, for example, be able to show you how a combination of different additives can cut the total additive content you need . . . possibly give added effectiveness, at less cost.

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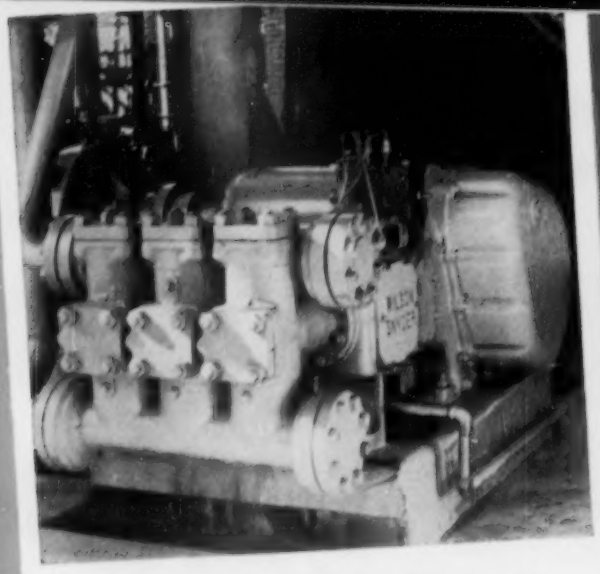
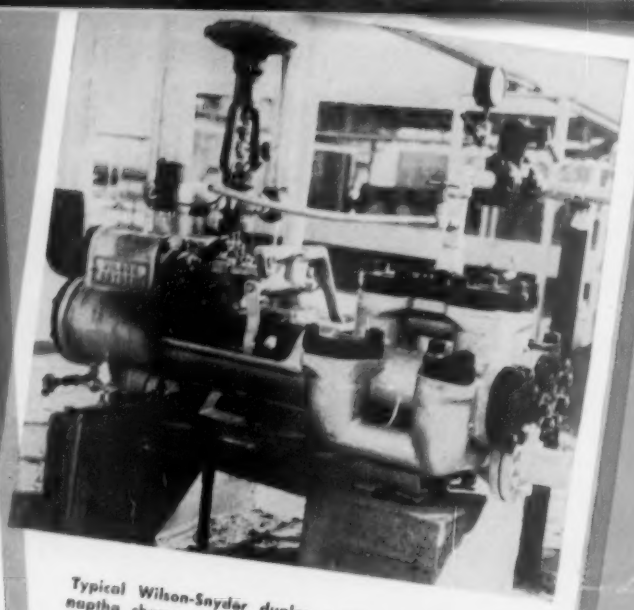


Typical Wilson-Snyder triplex plunger power pump in Universal Oil Products Platforming reactor charge service.



Typical Wilson-Snyder duplex steam pump handling naptha charge in an Atlantic Catforming installation.

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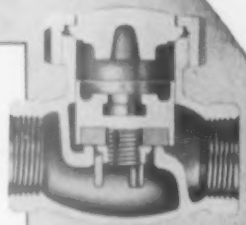
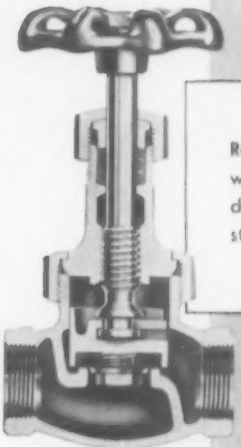
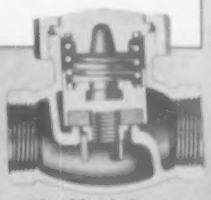


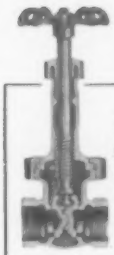
No. 93LPG Bronze
Check Valve — Regular



No. 91LPG Bronze
Globe Valve



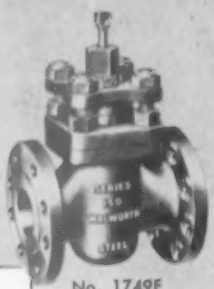
No. 88LPG Bronze
Check Valve — Spring Loaded



Metal-to-metal taper seat type split wedge gate valve, with specially treated stem packing. Metal-to-metal seat gate valves are limited by UL to branch or by-pass lines.

No. 29LPG Bronze Gate Valve

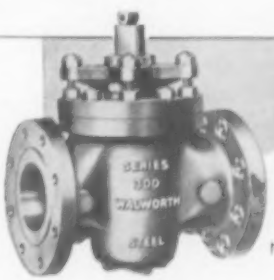
No. 1750



No. 1749F

Steel lubricated plug valves, wrench operated, having screwed or flanged ends and proper lubricant for LP-Gas service.

No. 1760



No. 1760F

National Board of Fire Underwriters' Pamphlet No. 58 lists requirements for LP-Gas service. Valves are intended for use where working pressures do not exceed 250 psi.—the maximum stop-to-discharge pressure setting of the relief valves on the LP-Gas systems on which they are to be used. This pressure does not necessarily match the manufacturers WOG rating. The Walworth valves illustrated here meet the UL requirements within the set limits. Your local distributor will be glad to furnish complete information, or write to:

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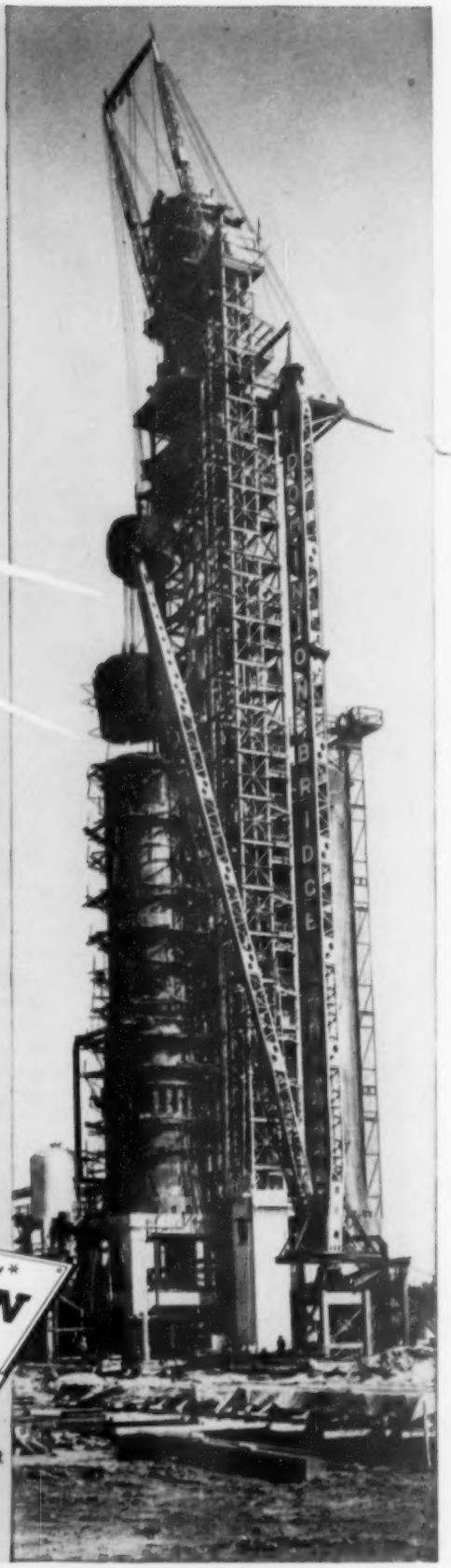
SOLVING PLATEWORK PROBLEMS



THIS PROBLEM, presented to us by the Sun Oil Company, Ltd. for their Sarnia refinery, through The Catalytic Construction Company of Canada, involved the fabrication and erection of the main vessels for the first Houdriflow unit ever built in this country. The kiln reactor measured 20 ft. 6 ins. (max.) diameter by 128 ft. high and weighed 325 tons. The surge hopper measured 15 ft. in diameter by 50 ft. high and weighed 70 tons.

FABRICATION PROBLEMS resulted from the size of the vessels and the numerous types of carbon, alloy and clad steel plate used to withstand process requirements; and from the complicated internal construction of the kiln reactor, with its 8 heads and 8 cooling coils composed of hundreds of pipes.

ERECTION PROBLEMS came from the fact that these massive vessels had to be field assembled to a total height of 270 ft. For this work, special lifting equipment, including a 150-ton guy derrick, was designed and built by Dominion Bridge Company.

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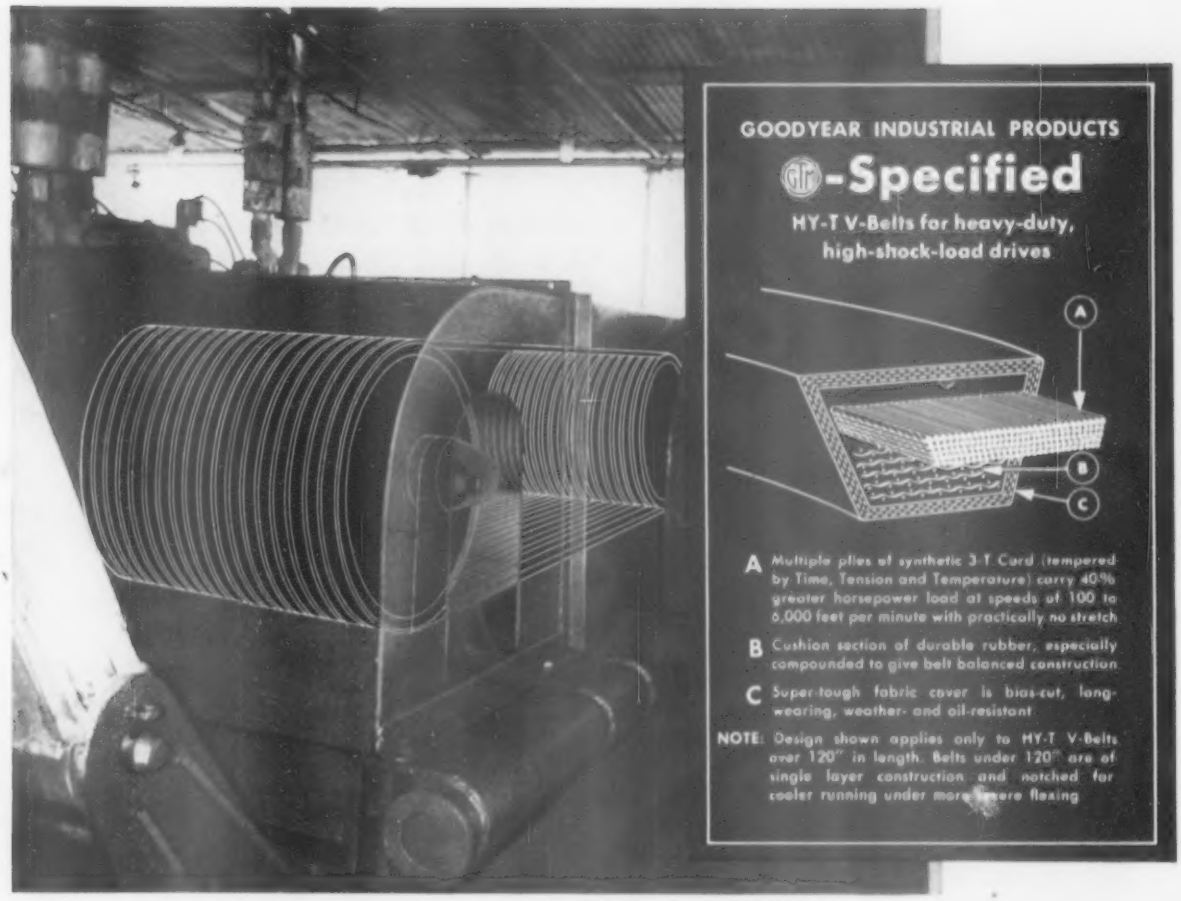

GOODYEAR INDUSTRIAL PRODUCTS
GT-Specified
HY-T V-Belts for heavy-duty, high-shock-load drives
A
B
C
A Multiple plies of synthetic 3-T Cord (tempered by Time, Tension and Temperature) carry 40% greater horsepower load at speeds of 100 to 6,000 feet per minute with practically no stretch
B Cushion section of durable rubber, especially compounded to give belt balanced construction
C Super-tough fabric cover is bias-cut, long-wearing, weather- and oil-resistant
NOTE: Design shown applies only to HY-T V-Belts over 120" in length. Belts under 120" are of single layer construction and notched for cooler running under more severe flexing

Service Increased 6 to 1

on tough oil-well, compound drive

SEVERE vibration. Frequent shock loads. Constant misalignment. Dust. Excessive oil. These were the conditions on a compound, draw-works drive in West Texas that limited the life of ordinary V-belts to a single hole—about 7,000 to 7,500 feet.

Since 30 belts were involved and a change-over took 6 to 10 hours at hundreds of dollars per hour, the operators soon called in the G.T.M.—Goodyear Technical Man. He specified matched sets of new oil-resistant HY-T V-Belts sinewed with Triple-Tempered (3-T) Cord (see blueprint).

RESULT: These new super-belts had the strength and resilience to soak up the shock and vibration—*drill over 46,000 feet—serve 6 to 7 times longer.* And were still going at last check.

Details on how HY-T V-Belts can harness your "belt killer" drives are yours by contacting the G.T.M., your Goodyear Distributor or Goodyear, Lincoln, Nebraska or Akron 16, Ohio.

YOUR GOODYEAR DISTRIBUTOR *can quickly supply you with Hose, Flat Belts, V-Belts, Packing or Rolls. Look for him in the yellow pages of your Telephone Directory under "Rubber Products" or "Rubber Goods."*

HY-T V-BELTS with 3-T CORD by

GOODYEAR

THE GREATEST NAME IN RUBBER

Hy-T-T. M. The Goodyear Tire & Rubber Company, Akron, Ohio

He skipped the same 2 valves again today

Both are still in adjustment. Still no leaks, not even at the shank! Both are OIC plug valves. If he's curious enough to dismantle one, he'll see the OIC gland and O-ring construction that saves him time and cussing. It's different from other plug valves he's seen.

Three efficient seals prevent shank leakage on OIC plug valves. Concentric grooves machined into the gland liner form a "labyrinth" seal. The liner also retains an O-ring in contact with the plug's top face for a second positive seal. And resilient packing between gland and gland liner forms the third seal.

But the maintenance man measures design by *results*. OIC plug valves get his O. K. because they stay in adjustment a long time without leakage. However, if *you* are interested in the exclusive gland design and construction of these OIC plug valves, write for specification literature.

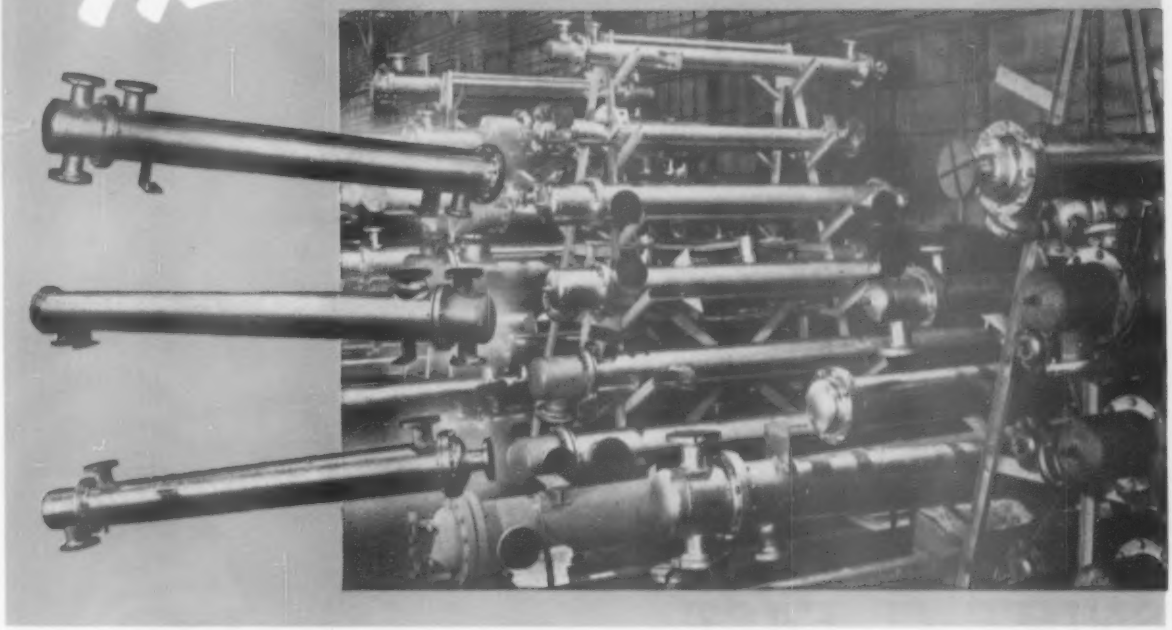
The Ohio Injector Company • Wadsworth, Ohio

OIC VALVES

FORGED & CAST STEEL, LUBRICATED
PLUG, BRONZE & IRON VALVES

Struthers Wells

Standard HEAT EXCHANGERS



Struthers Wells now offers a line of Standard heat exchangers—in sizes from 20 to 400 square feet of surface—including fixed tube sheet, floating head and U-tube units. Condensers, coolers, heaters and reboilers can be supplied in single and multipass tube arrangements.

Standard heat exchanger construction includes materials of carbon steel, non-ferrous alloy, and stainless alloys Type 304 and Type 316. Equipment meets highest construction standards, including ASME Code and TEMA Class A.

Typical units are illustrated above, including a partial view of those in stock, ready for immediate shipment. Standardization of design and quantity manufacture enables us to offer this equipment at very reasonable cost.

STRUTHERS WELLS PRODUCTS

PROCESSING EQUIPMENT DIVISION

Crystallizers . . . Direct Fired Heaters . . . Evaporators . . . Heat Exchangers . . . Mixing and Blending Units . . . Quick Opening Doors . . . Special Carbon and Alloy Processing Vessels . . . Synthesis Converters

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BOILERS for Power and Heat . . . High and Low Pressure . . . Water Tube . . . Fire Tube . . . Package Units

FORGE DIVISION

Crankshafts . . . Pressure Vessels . . . Hydraulic Cylinders . . . Shafting . . . Straightening and Back-up Rolls

MACHINERY DIVISION

MACHINERY for Sheet and Structural Metal Forming . . . Tangent Benders . . . Folding Machines . . . Roller Table and Tumble Die Bending Machines . . . Press Brakes . . . Punching and Notching Machines . . . Forming Dies

Any Size Available for Quick Delivery!

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WARREN, PA.

Plants at Warren, Pa. and Titusville, Pa.

Offices in Principal Cities

OIL FIRE!

SNUFF IT FAST WITH POWER PLUS!

AIM THE HORN, pull the trigger, and wham! Another stubborn oil blaze dies... thanks to the extra fire-killing power of Kidde Dry Chemical Extinguishers!

Examine a Kidde Dry Chemical Extinguisher closely, and you'll see why Kidde is first choice with firefighting experts the nation over. These lightweight extinguishers (for fast, easy aiming) have Kidde's patented diffuser horns which give you up to 44% *more* coverage than you get with conventional dry chemical extinguishers. Dependable and easy to operate, Kidde's special trigger-finger grip permits even a novice fire fighter to tackle a blaze immediately . . . with confidence.

Especially effective in fighting fires in L-P gas, oil, gasoline and other flammable liquids, Kidde Dry Chemical Extinguishers will not pack. Cartridge-operated Kidde extinguishers are available in 20 and 30-pound capacities, while Kidde pressure-operated models come in capacities of 5 and 10 pounds. All Kidde pressurized extinguishers have easy-to-read, dustproof pressure gauges, can be charged to U.L.-approved working pressures (150 pounds) at any commercial air pump. In addition, the 10-pound model can be charged to 250 pounds for extra fire-fighting punch! It is U.L.-approved at either pressure.

For more information on the complete Kidde Dry Chemical line, write today for Kidde's Catalog P-8.

Kidde 20-pound dry chemical portable

Kidde

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THESE SILOS FEED INDUSTRIAL NEEDS

Fodder for virtually every industry—in huge amounts for many, down to laboratory quantities for others—is contained in these storage bins, known to the trade as silos. Unlike their counterparts in agriculture, which store against the winter season, the turnover of their contents is relatively constant. For these silos hold Soda Ash—historically the oldest of all major industrial chemicals in use today.

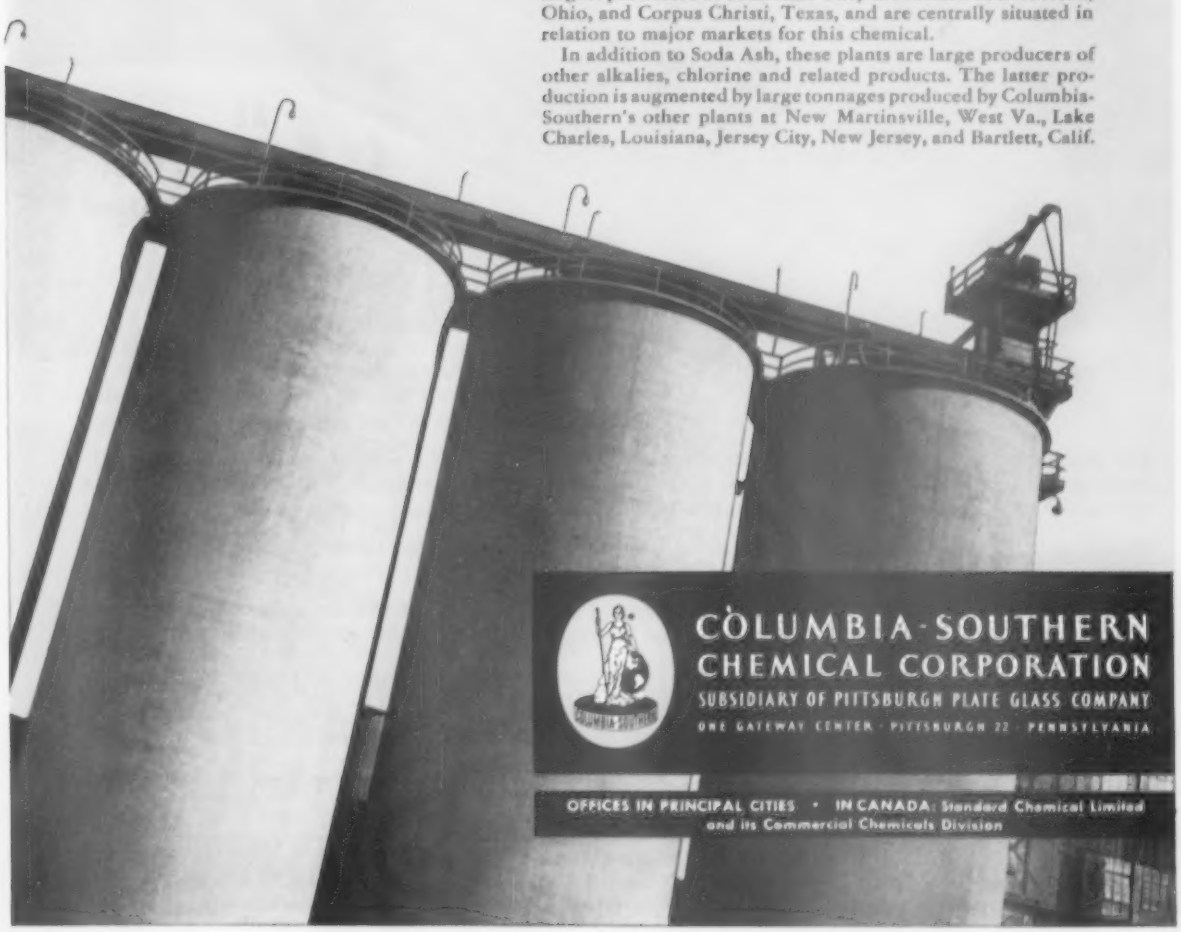
So varied and essential are the uses of Soda Ash that its consumption is a very accurate index of national commercial prosperity. Soda Ash is a basic ingredient of glass, which represents the largest single use, being surpassed only by the aggregate requirements for the production of other chemicals. Other major industrial uses include soap, cleansers and detergents, pulp and paper, textiles, metal refining, water treatment and petroleum refining.

Columbia-Southern's production of Soda Ash dates from its first operations in 1899. Through constant expansion, it has maintained its position as one of the nation's leading producers of Soda Ash and other alkalies —and a reliable source of supply for all industry.

COLUMBIA-SOUTHERN PRODUCES SODA ASH IN LARGE VOLUME AT TWO LOCATIONS

Two of Columbia-Southern's six plants are among the nation's largest producers of Soda Ash. They are located at Barberton, Ohio, and Corpus Christi, Texas, and are centrally situated in relation to major markets for this chemical.

In addition to Soda Ash, these plants are large producers of other alkalies, chlorine and related products. The latter production is augmented by large tonnages produced by Columbia-Southern's other plants at New Martinsville, West Va., Lake Charles, Louisiana, Jersey City, New Jersey, and Bartlett, Calif.



COLUMBIA-SOUTHERN CHEMICAL CORPORATION
SUBSIDIARY OF PITTSBURGH PLATE GLASS COMPANY
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OFFICES IN PRINCIPAL CITIES · IN CANADA: Standard Chemical Limited and its Commercial Chemicals Division

TYPE 8-B

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Here, at the largest and most modern refinery on the West Coast, you'll find a complete line of "John Crane" Seals. Specifically designed for refinery service, these seals were selected for their ability to handle difficult liquids.

For instance, you'll find Type 8-B Seals handling propane at 100°F., 700 psi., spg. 0.475 . . . Type 1-B Seals on 4-stage pumps handling liquids at 190°F., 500 psi . . . Type 2 Seals in ethane-butane service at 90°F., 235 psi . . . others handling gasoline at 110°F., 445 to 460 psi.

These seals, in combination with the "John Crane" Type 9 Seal (incorporating sealing member of DuPont Teflon), are used in refineries everywhere.

The "John Crane" Type 9 Seal is especially adapted to handling light hydrocarbons and similar services where rubber sealing members cannot be used because of high temperatures and corrosive action.

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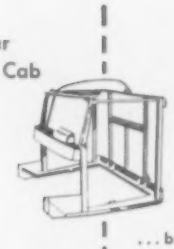
JOHN CRANE **CRANE PACKING COMPANY** 38 YEARS INDUSTRIAL PROGRESS



. . . built like a skyscraper

"TYPICAL OF SO MANY AUTOCAR EXTRAS"

W. H. Ford has been using Autocars in his fleet since 1932

THAT'S W. H. Ford, president of Ford Bros., Inc., of Ironton, Ohio, in the driver's seat of that husky AUTOCAR. Ask him about the AUTOCAR Driver Cab and the AUTOCAR "Ful-Adjust" Driver Seat. "Best cab ever installed on a truck. Our drivers are most enthusiastic about it . . . typical of so many Autocar extras," he says.

PERFORMANCE—that's another AUTOCAR extra! "We use Autocars in severe hills and mountainous terrain. We've improved tremendously on normal road speed and grade-ability with Autocar power to take advantage of maximum payload and move with today's heavy flow of traffic," Mr. Ford says.

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19C

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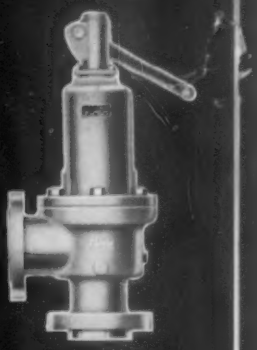
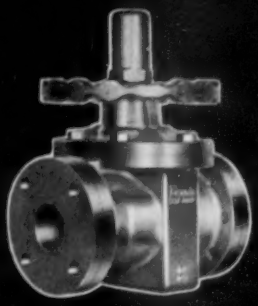


1945



Pinch Type Flexible
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Farris Flexible Valve Corp.

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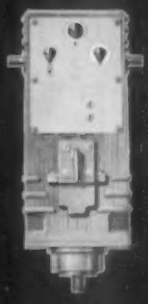

1951

U. S. Patents and Patents Pending

1955

.. through honest purpose"

The larger and more experienced a manufacturer becomes, the more he appreciates that PROGRESS is not restricted to simply producing fine products at fair prices. Rather, it is the sum total of all the services he renders to his customers day by day and year by year. It is unceasing vigilance to assure customer satisfaction . . . it is constant concern for improvement—for *better* products at even *better* prices . . . it is strict adherence to a commercial code of honor, like Farris' policy of "Progress—Through Honest Purpose".

Evidence of this policy's success is seen in the rapid and constant growth of the Farris organization. And even as you read this, more facilities are being added . . . designed to provide even greater service for users of Farris Safety and Relief Valves (which have set the pace in design and performance and have been duplicated by other manufacturers), Farris "SuperSeal" Flex Valves and Farris Pickering Governors.

Behind our continuing growth and the world-wide recognition of Farris as a pacesetter in its field, is the fundamental belief that "honesty of purpose" when dealing with people is always to be trusted. Upon this belief we have grown . . . and, because they believe in the same things, our customers and friends have supported us. Here, beyond doubt, is proof that the right way to grow is THROUGH HONEST PURPOSE.

and HOUSTON, TEXAS 1955

PROGRESS THROUGH Farris HONEST PURPOSE

AFFILIATED COMPANIES

400 COMMERCIAL AVE., PALISADES PARK, N. J.

- Farris Engineering Corp.
- Farris Flexible Valve Corp.
- Farris Pickering Governor Co., Inc.
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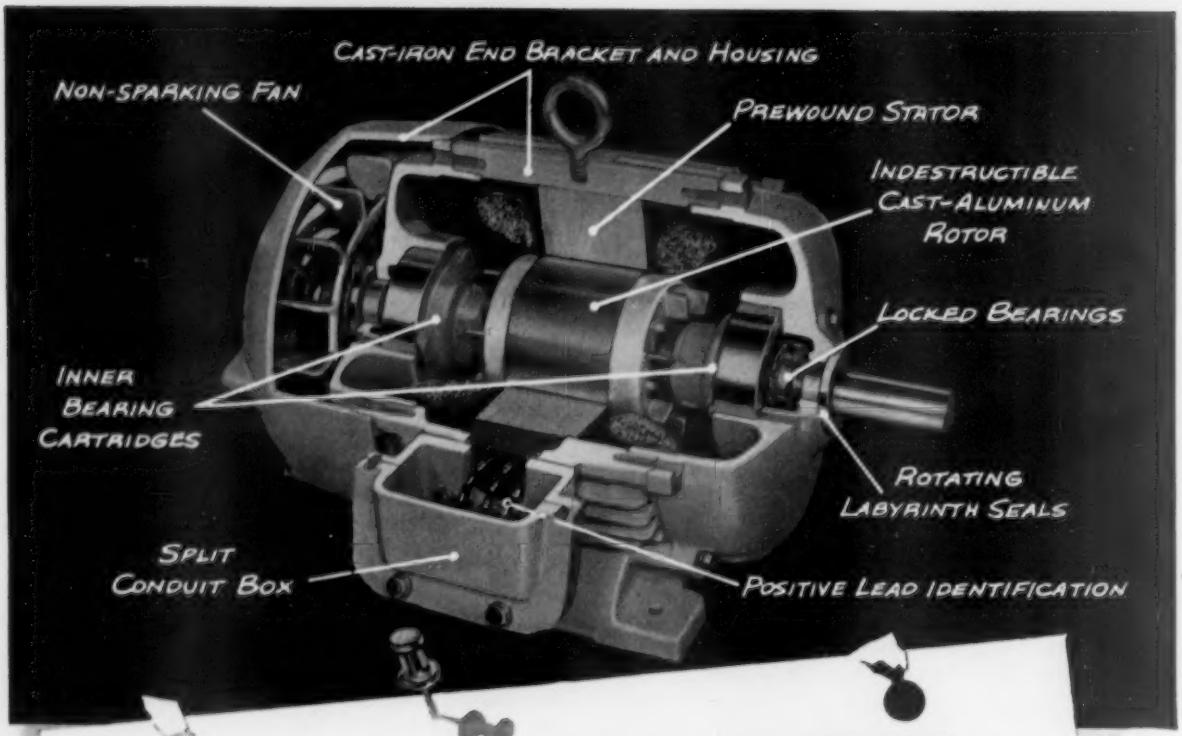


Are you getting all these extras in the motors you buy?

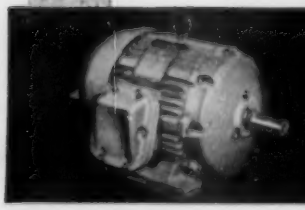
Louis Allis gives them to you in the new L. A. enclosed and explosion-proof motors

For years, Louis Allis has specialized in special motors for many of industry's toughest drive problems. Such installations call for extreme care in both motor design and manufacture—care that has become a habit with us. We build our enclosed and explosion-proof motors with the same special care.

What does this mean to you? It means that you get a motor with extra features—a motor that runs better, lasts longer. Here are a few of the extra reasons why:

- These new motors carry Underwriters' label for use in four groups of hazardous locations—Class I, Group D, and Class II, Groups E, F, and G. This four-group approval for a single motor simplifies your stocking problem.
- New, exclusive phenolic impregnating varnish provides high thermal and chemical resistance. It remains resilient and resists aging, prolonging the life of the motor.
- Inner bearing cartridges lock bearings to end bracket and form explosion-quenching seal along the shaft. Inner race of bearing locked to shaft, reducing end play—an extra quality feature.
- Rotating labyrinth seals keep dirt and moisture out of the bearings—keep grease in.

There are many other features such as a new diagonally split conduit box, sturdy cast-iron construction, positive lead identification, non-sparking fan. Our new bulletin No. 1700 shows why you get extra value for your dollar in a Louis Allis explosion-proof motor. Write for your copy.



New LA line explosion-proof motors are available in rerated frame sizes 182 through 326U, and in ratings of 1 to 30 hp, 3 phase, and 1 to 5 hp, single phase. Also available with Underwriters' approval for Class I, Group C hazardous locations.

EP-102

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Your Wickwire Rope distributor is a good man to know. He's quality people handling quality products. Buy your wire rope and wire rope slings from him. You'll find that the many valuable services he offers far outweigh any apparent price advantage you might gain by buying direct.

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Yes, Avondale has built them all—fabricated them, repaired them. Avondale-built equipment pioneered the search for oil in the waters of the Gulf of Mexico; and Avondale-built equipment is everywhere today, doing a job for oil companies and drilling contractors. Avondale's products for the Oil Industry are known throughout the world—their design, workmanship and dependability unsurpassed.

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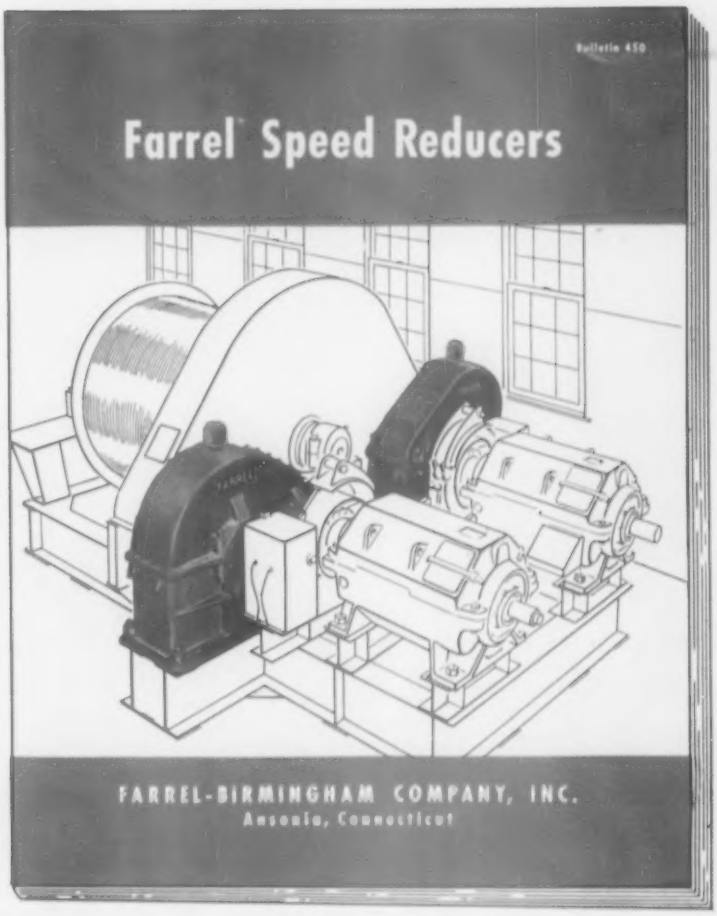

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All the information you need for quick selection of speed reducers for any application is in this comprehensive new book. Included are specifications, horsepower rating tables, overhung load capacities, dimensions and weights of the large variety of units comprising the Farrel line. This line has been recently re-engineered, rerated and expanded.

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HYDRECO Gear-Type Hydraulic Pumps, 3 to 120 gpm; Fluid Motors, 3 to 52 hp; Cylinders; Control and Auxiliary Valves; 1500 psi. DUDCO Dual-Vane Hydraulic Pumps, 3 to 120 gpm; Fluid Motors, 7 to 140 hp; 2000 psi operation.

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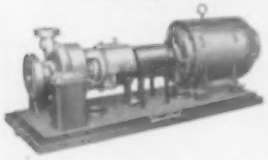
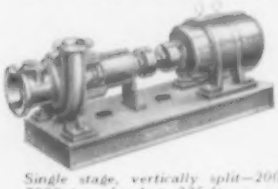


Single stage, vertically split—20-3200 gpm, heads to 600 ft.

Single and two stage, vertically split—20-3500 gpm, heads to 1100 ft.

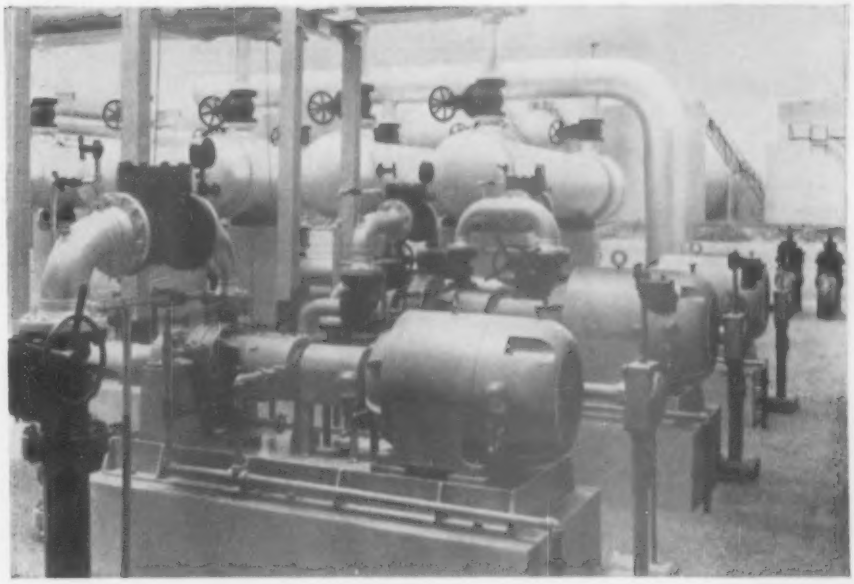


Single stage, vertically split—200-7000 gpm, heads to 225 ft.

Multi-stage horizontal diffusor type—450-3000 gpm, heads to 6000 ft.

Multi-stage vertical diffusor type—20-400 gpm, heads to 4800 ft.

Single or multi-stage vertical turbine pumps—60-35,000 gpm, heads to 150 ft. per stage.



How IR refinements in pump design mean long range savings in REFINERY SERVICE

What determines your choice when selecting a pump for a given job?

You want the pump that gives you the *most* for the money—the most *dependable* service, highest *sustained* efficiency, and lowest year-after-year maintenance cost. And all these result from refinements in pump design and manufacture.

In all I-R process pumps, these refinements have been carried to the fullest extent. Unsurpassed metallurgical facilities assure proper material selection and heat treatment of all pump parts to meet actual service conditions to best advantage. Casings, impellers, wearing rings, shaft sleeves are built of materials formulated to minimize the effects of corrosion, erosion, expansion and thermal shock.

Running clearances of all moving parts are proportioned not just for a high initial efficiency, but for maximum sustained efficiency year after year. Easier accessibility for inspection or servicing cuts down-time. Extensive interchangeability of parts throughout the entire I-R line simplifies stocking of replacement parts.

Your Ingersoll-Rand representative will be glad to give you the complete story on the extra-value features of any I-R pump. His specialized design and application experience can save you time and effort on any job.

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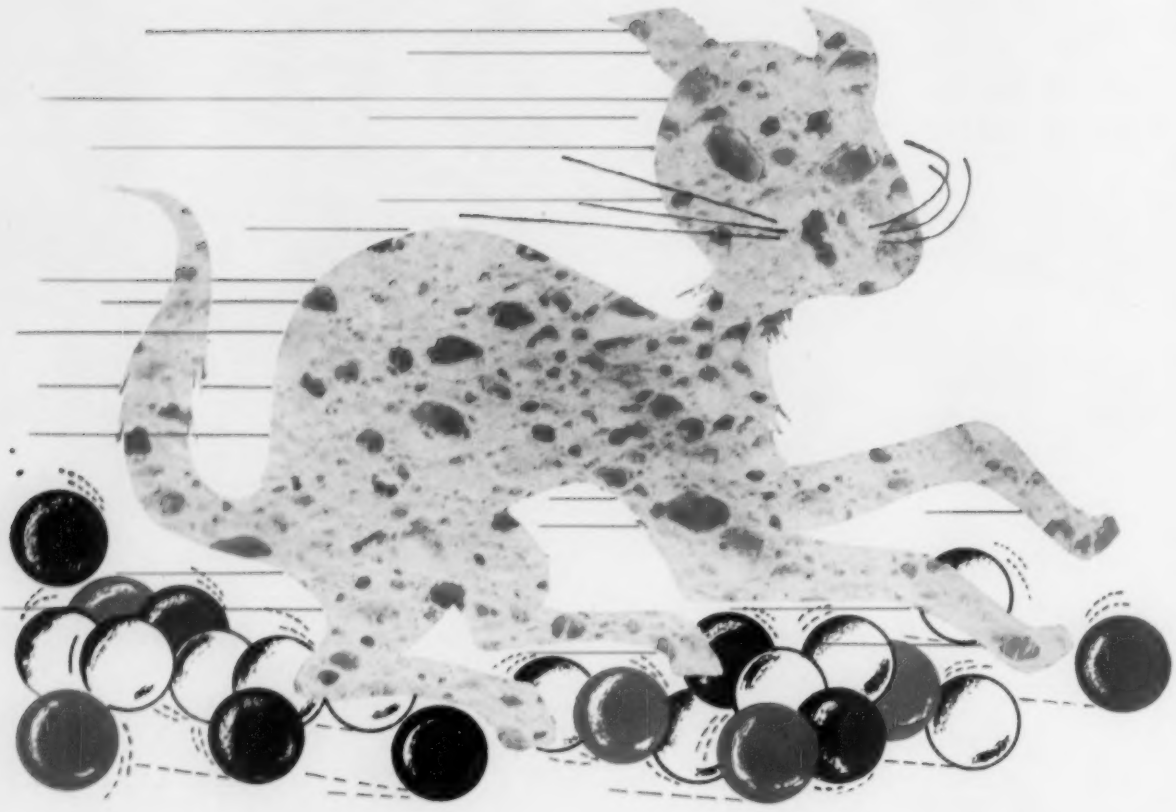

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balanced HI PV* Aerocat® Catalysts

Circulation improves and stack losses drop when catalyst particles are free of snags and corners that impede flow and break off to make fines.

Good sphericity is characteristic of Cyanamid's AEROCAT Catalysts. Balanced with particle size distribution and hardness, sphericity boosts efficiency of catalytic cracking. And to provide exceptional thermal and steam stability, high pore volume is carefully adjusted with pore diameter and specific surface.

Results in cat cracking unit performance are attested by extensive commercial experience, which your Cyanamid representative will be glad to review with you. Ask him today about AEROCAT, and the importance of a *balanced* HI PV catalyst.

*Trademark
®Registered Trademark

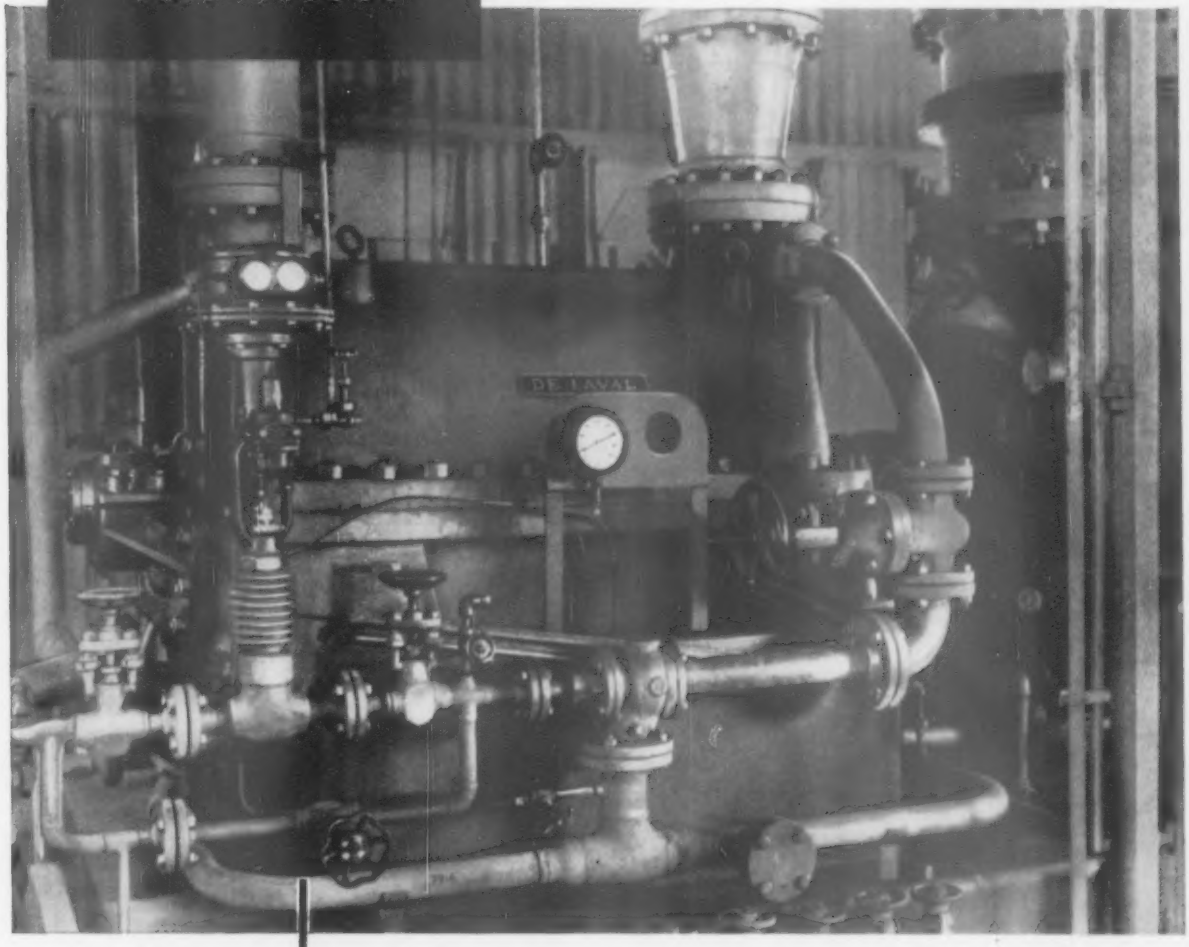
CYANAMID

AMERICAN CYANAMID COMPANY
REFINERY CHEMICALS DEPARTMENT
30 Rockefeller Plaza, New York 20, N.Y.

In Canada: North American Cyanamid Limited, Toronto and Montreal

DE LAVAL CENTRIFUGAL COMPRESSOR

handles hydrocarbon gas in Sunray Oil refinery



This De Laval 7-stage centrifugal gas compressor, installed at the Duncan, Oklahoma refinery of the Sunray Oil Company, handles a heavy hydrocarbon gas in a delayed coking process. The gas has a molecular weight of 31.5.

The De Laval centrifugal compressor is rated at 2340 inlet cfm; discharge pressure is 240 psia. The power required is 1350 bhp with compressor operating at 9900 rpm.

Sunray Oil is another refinery which has selected De Laval compressors for heavy-duty continuous service. Rugged, horizontally split casings, individually designed impellers, perfectly balanced rotors and externally mounted, cylindrically seated bearings are design features that assure optimum performance and long service.

Send for new Bulletin 0504

DE LAVAL *Centrifugal Blowers*

DE LAVAL STEAM TURBINE COMPANY
810 Nottingham Way, Trenton 2, New Jersey

DL 327

Hard faced to resist seat wear

WITH STELLITE

...at no extra cost!

GP Globe Valve-Series 800

Stubborn resistance to valve seat wear, due to erosion, corrosion and galling, is built into Vogt GP valves with Stellite faced seating surfaces used in conjunction with hardened discs and wedges. By an exclusive method, hard facing alloys are welded to the integral seat of globe and angle valve bodies and to the removable stainless steel seat rings of gate valves.

This important feature, available at no extra cost, assures operation economies and longer valve life. A catalog describing the complete General Purpose line of valves in sizes 1/4" to 2" will be sent on request.

Adv. No. 3 in a series describing the features of Vogt GP valves.

Write For Your FREE COPY of Supplement No. 1 to Catalog F-9. Address Dept. 24-FO.

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P. O. Box 1918 • Louisville 1, Kentucky

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Vogt GENERAL PURPOSE GP Vogt FOR BETTER VALVES

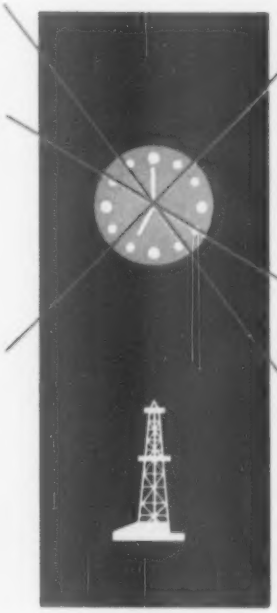
DROP FORGED STEEL

VALVES

CUTS RIG TIME THREE WAYS
On Squeeze Jobs

HALLIBURTON'S

hydraulic RETRIEVABLE CEMENTER



In three ways, Halliburton's Hydraulic Retrievable Cementer (HRC) saves costly rig time on squeezing cement, pumping acid, testing casing or tubing.

FIRST WAY: Speedy Operation. Friction drag blocks allow Halliburton's HRC to be started in the hole without difficulty. Because of porting design, tool can be run into hole rapidly without overflow of fluid in tubing, and sand bridges encountered can be pumped out through the tool. When tool reaches desired depth, very simple drill stem manipulations are used to operate it, since other operations are performed hydraulically.

SECOND WAY: Only One Round Trip. Halliburton's HRC can be set, released and reset as many times as desired for successive jobs, without coming out of the hole.

THIRD WAY: No Drilling-out Time. Because of retrievable feature, there is no time-consuming drilling out of tool metal.

Many other operating features and rugged construction make this as fine a tool as you would expect from Halliburton, with its three-million-job experience and policy of giving customers the best possible service.

Let Halliburton do your next remedial squeezing or acidizing job. You'll see that equipment like the Retrievable Cementer, plus Halliburton service, will pay off in performance and time-saving. Call your local or district office of the Halliburton Oil Well Cementing Company.

COMPLETE DATA SENT ON REQUEST

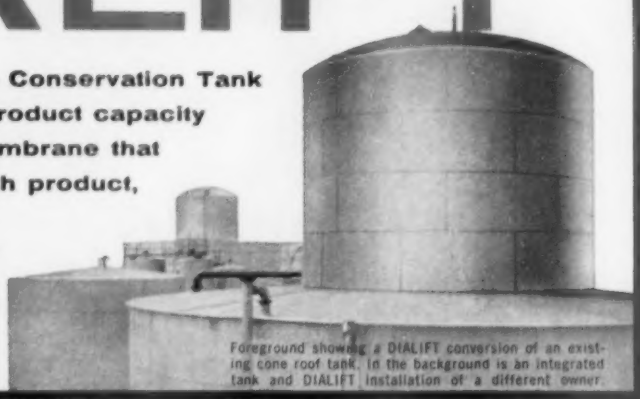
Get this valuable information for your Halliburton Service File.

HALLIBURTON CEMENTING SERVICES

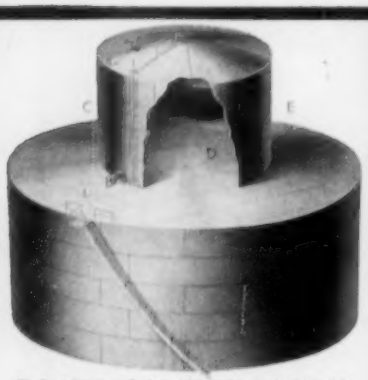
250 SERVICE CENTERS — JUST MINUTES AWAY FROM ANY RIG

The HAMMOND DIALIFT

The ONLY membrane type Conservation Tank with full-rated vapor and product capacity AT ALL TIMES, with a membrane that cannot come in contact with product, vapor space that can be isolated for inspection and maintenance without taking product storage tank out of service.



Foreground showing a DIALIFT conversion of an existing cone roof tank. In the background is an integrated tank and DIALIFT installation of a different owner.



Principle of the Hammond Dialift

A—DIALIFT DIAPHRAGM rises and falls to accommodate expanding and contracting vapor.
B—Vapor passes to and from tank and DIALIFT through simple elbow connection.
C—DIALIFT and tank have full-rated capacity.
D—Membrane can't come in contact with product.
E—DIALIFT can be isolated for maintenance and inspection, product tank stays in service.

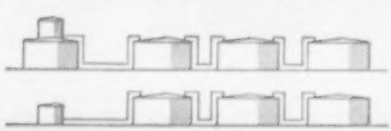
The most efficient and economical vapor conservation system for new or old tanks.

THE HAMMOND DIALIFT consists of a gas-tight Vulcalock membrane attached to the inside periphery of a cylindrical metal housing to become a "breathing" apparatus to accommodate the expanding and contracting vapor as developed in product storage tanks. The DIALIFT can be used as a single conservation unit by being attached to the roof of a product storage tank or as a central "breathing" system by being manifolded to a number of product storage tanks. There are two forms of installation: —Ground type manifolded to a number of tanks to form a conservation system and integrated type whereby the DIALIFT is attached to the roof of a product tank for vapor conservation for one or a number of tanks.

The DIALIFT is completely isolated from the product storage tank. Vapor passes between the tank and DIALIFT through a vaporline connection. It is easy to convert old cone roof tanks to efficient vapor-saving DIALIFT installations by attaching a DIALIFT housing with membrane to the roof of the old tank and connecting the vaporline between the tank and DIALIFT.

New or converted DIALIFT tank, inter-connected with cone-roof tanks, becomes central "breathing" unit.

DIALIFT GROUND UNIT serves as central "breathing" apparatus of multi-tank conservation system.



THE HAMMOND DIALIFT ELIMINATES BREATHING LOSS AND REDUCES FILLING LOSS

Write for catalog 55DL

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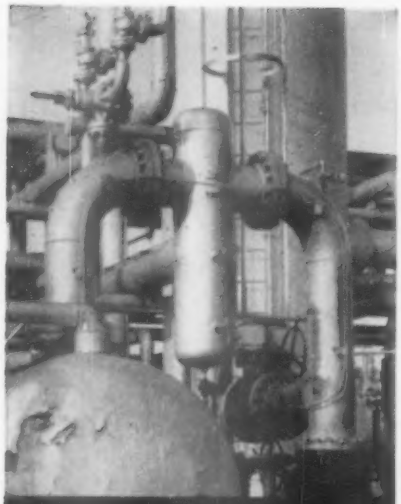
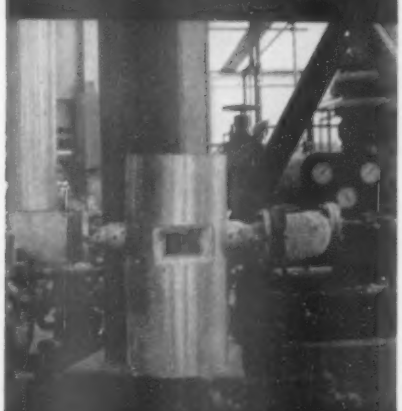


A Peerless Line Separator is shown above removing entrainment from a refinery reboiler.

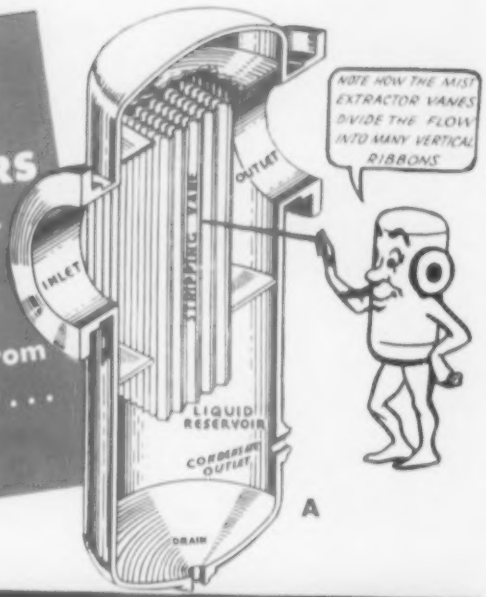
Peerless Line Separators are doing an effective job of mist extraction at this Kentucky Petrochemical Plant.

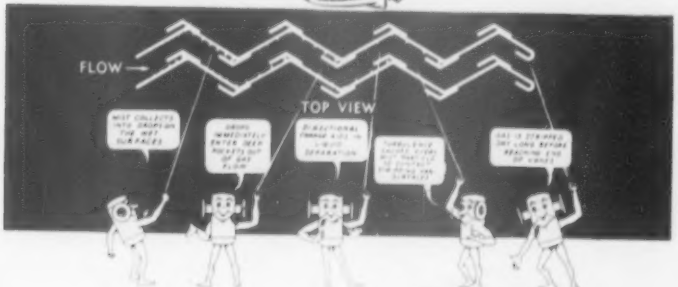


This is an insulated Peerless Steam Separator on a turbine driving an airblower.

PEERLESS LINE SEPARATORS

Outstanding for the efficient extraction of liquid mist from gas or steam . . .





HIGH EFFICIENCY — HIGH CAPACITY LOW PRESSURE DROP

Thousands of installations throughout the Refining and Chemical industry have proven the Peerless Line Separator principle to be one of the most outstanding methods available for the extraction of liquid from gas, steam or air.

Drawing A above shows the arrangement of the vanes in the Separator. Drawing B is an illustration of the Peerless principle.

The mist extractor combines the forces of impingement, centrifugal motion and surface tension to obtain its high efficiency. The path of the gas, etc., through the unit is constantly bending, causing semi-violent turbulence and rolling of the gas against the walls of the vane. Impingement and centrifugal force combine to contact the droplets with the vanes, where they coalesce, and surface tension then causes them to cling to the vanes' surfaces. Gravity and the impact of the gas stream then drives the droplets into the pockets where they roll down the vanes and out of the gas stream.

Through the Peerless method of mist extraction, the gas is stripped dry long before reaching the end of the vanes.

there's A PEERLESS SEPARATOR FOR EVERY REQUIREMENT

For any capacity
For any working pressure
For corrosive conditions
With removable vane units
With extra body length
With connections for accessory equipment
For pressure drop requirements of less than 6" water
For any vapor-liquid ratio
For any piping requirement

SPECIAL DESIGN SEPARATORS FOR ANY REQUIREMENT

FOR FURTHER INFORMATION ON THE USE OF PEERLESS LINE SEPARATORS PLEASE WRITE FOR NAME OF NEAREST PEERLESS ENGINEER.

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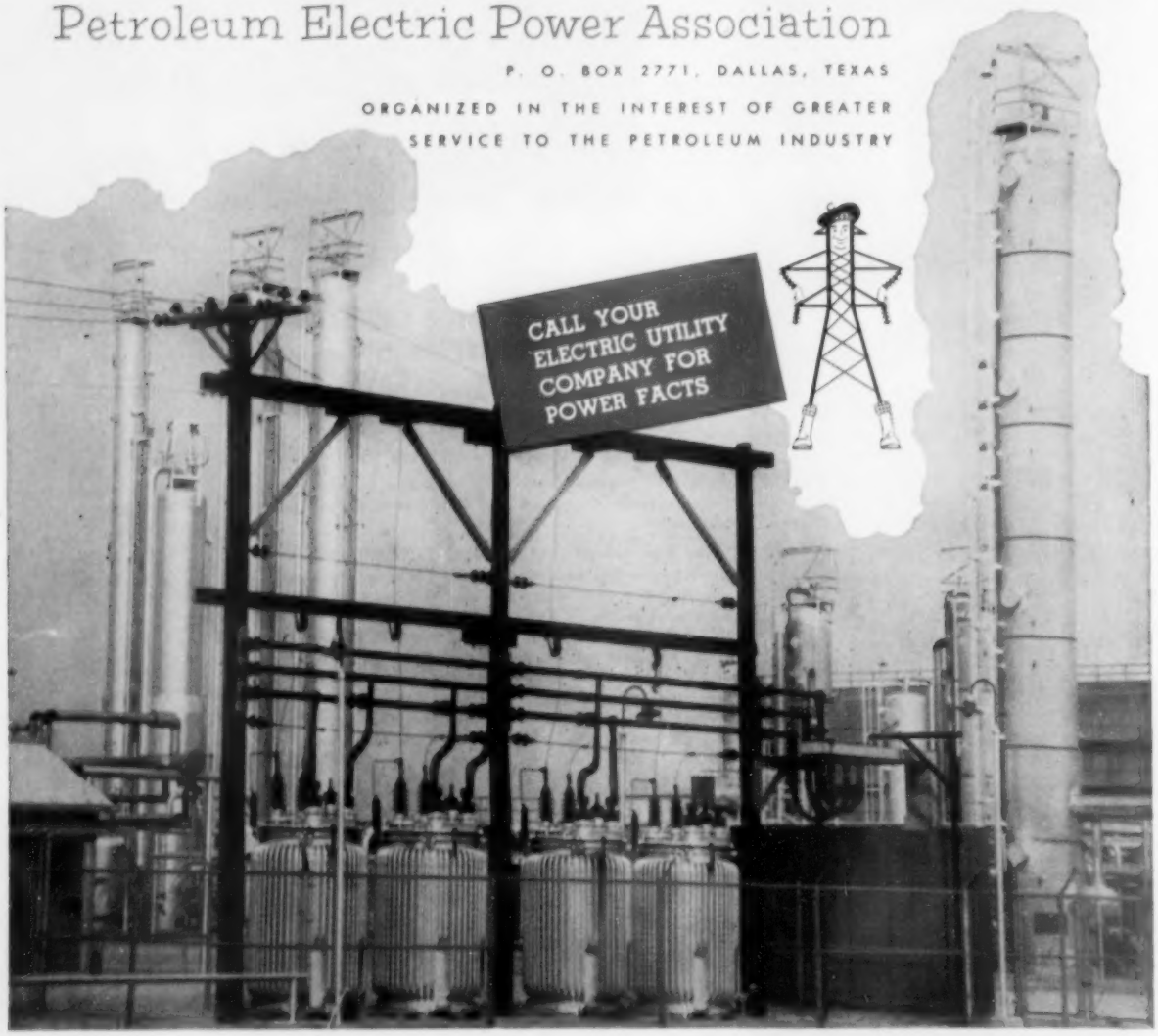

the FRONTIER spirit lives again . . .

A happy aspect of frontier days was the spirit of helpfulness among the early settlers. You could always count on the neighbors to lend a hand in a tough spot.

We try to keep this spirit alive today at Frontier Chemical. We try to offer an extra measure of helpful service to our customers – in urgent and normal situations alike. Our strategic plant locations, for example, offer time and transportation savings to many users throughout the Southwest and Mid-America. Fast, reliable deliveries via our own truck and tank car fleets often reduce chemical stockpile requirements and create additional savings.

In our ten years of existence, we have qualified as regular suppliers to some of the best known firms in the oil industry. We invite you to try Frontier service. We believe you'll like it.

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CAUSTIC SODA • MURIATIC ACID • CHLORINE • 99% PURE SALT

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CHAMPS OF EVERY

NEW 1956 CHEVROLET

WEIGHT CLASS! CHEVROLET

New Chevrolet trucks for '56 bring you new heavies, middleweights and lightweights in eight great new series—new power and performance to save more money on your hauling job!

New Heavyweights—New Tandems! All-new heavyweights in 9 wheelbases, with maximum G.V.W. ratings up to a new high of 32,000 lbs.; G.C.W. up to 50,000 lbs.

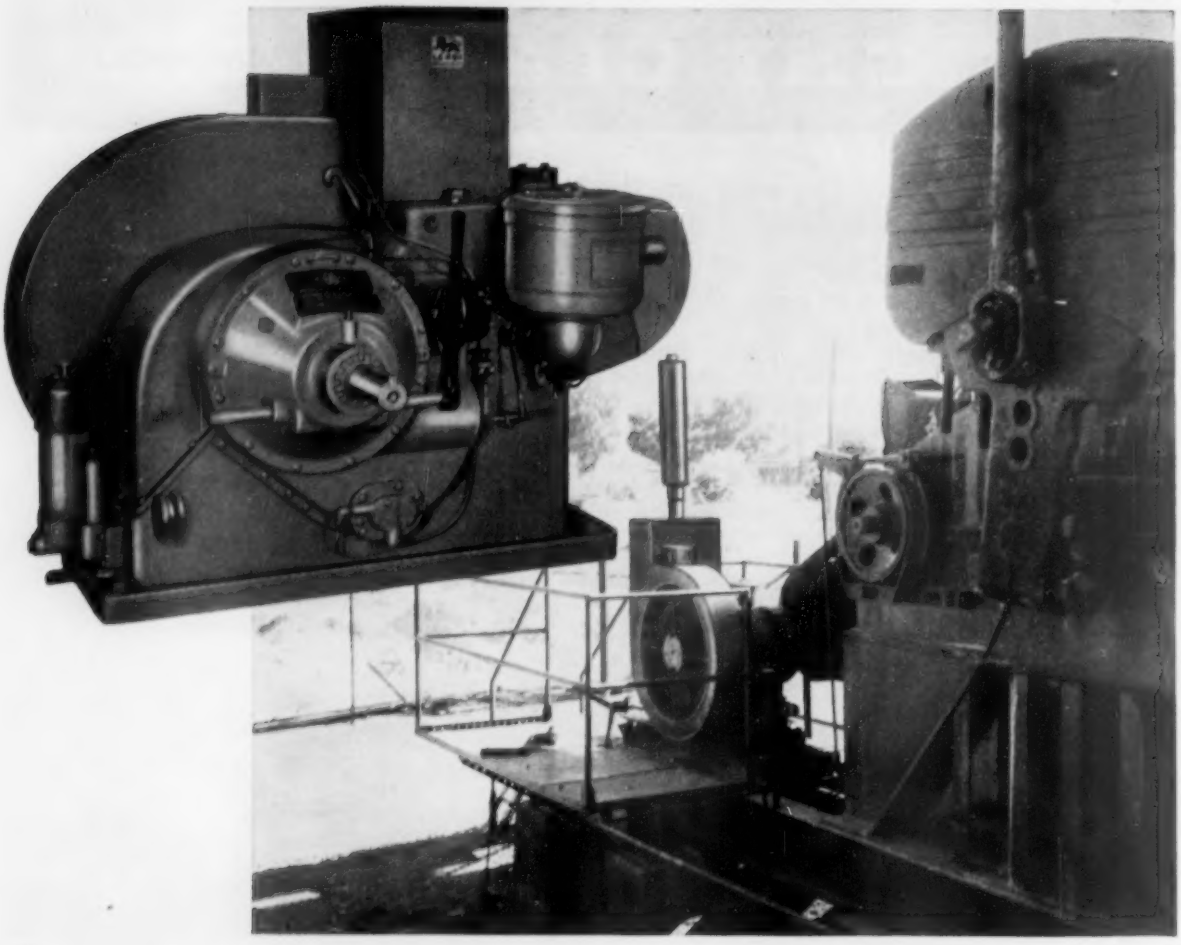
Ultra-Modern Features! Tubeless tires, standard; High-Level ventilation and panoramic visibility; plus Concealed Safety Steps on most models.

Wider Range of Drives! There's an automatic drive in every series with new Powermatic for most middleweights and heavies; Hydra-Matic for light-duty models. Both extra-cost options. A new 5-speed transmission is standard in 9000 and 10000 series models; optional at extra cost in other heavies and most medium-duty models. New heavy-duty 5-speed is an extra-cost option in models with new Loadmaster V8.

A Modern V8 for Every Model! And introducing the completely new 322-cu.-in. Loadmaster V8, standard in new 9000 and 10000 series heavyweight models.

See Your Chevrolet Dealer and his new Task-Force line before you buy. . . . Chevrolet Division of General Motors, Detroit 2, Michigan.

TASK·FORCE TRUCKS



Total Operating Cost Only 1.2 Mills per Hp Hour

. . . that's why it pays to do your pumping with Le Roi A288's

ACCORDING to the major oil company using this 26.3 max. hp A288, this operating cost is lower than that of any of their other engines.

And here are some of the reasons why the A288 cuts the cost of pumping — why it can run two weeks at a time without inspection.

Patented, "vaporizing-condensing" cooling system seldom needs make-up water. Uniform high temperatures reduce corrosion and sludging.

No superfluous acccessories like grease fittings, conventional-type fan and belts to need attention.

Generous crankcase permits long intervals between oil changes — and no shutdown is required to inspect oil level or add oil.

And performance-wise, you can't beat the A288, or the smaller 14.9 max. hp A114 sister engine, either. One typical installation has more than 47,000 hours on it. Stamina like this is one reason why the A288 is the only pumping engine recommended by a major user for continuous service *unattended for up to two weeks' time.*

Standardize on A288's and watch your pumping costs drop. You can get them from your supply house, or your Le Roi distributor. Or write us for our latest bulletin.

LE ROI *Division of Westinghouse Air Brake Co.*

Milwaukee 1, Wisconsin. Oilfield Headquarters, Tulsa, Oklahoma

P-138

THIS ONE'S ON US!

• We'd like a chance to help you with your refinery tubing problems —at no obligation to you. Over the past 60 years, National Tube's refinery specialists have come up against practically every existing refinery problem. From this long and varied experience we have developed 24 different steel tube analyses . . . each designed to control specific refinery conditions such as exposure, oxidation, acids, corrosion, pressure, and high and low temperatures. Every one of these analyses has been tested time and again in actual refinery service so that we know exactly what each one will do. Other chemical compositions are also available in tubular products, and a wide variety of high temperature problems are presently under study.

So be our guest. We'll lend an attentive ear to your refinery problems and do our utmost to find the tubing analysis that will do the best job for you at the lowest cost. Write to National Tube Division, United States Steel Corporation, 525 William Penn Place, Pittsburgh 30, Pa.

HERE ARE OUR TWO DOZEN STEEL TUBE ANALYSES:

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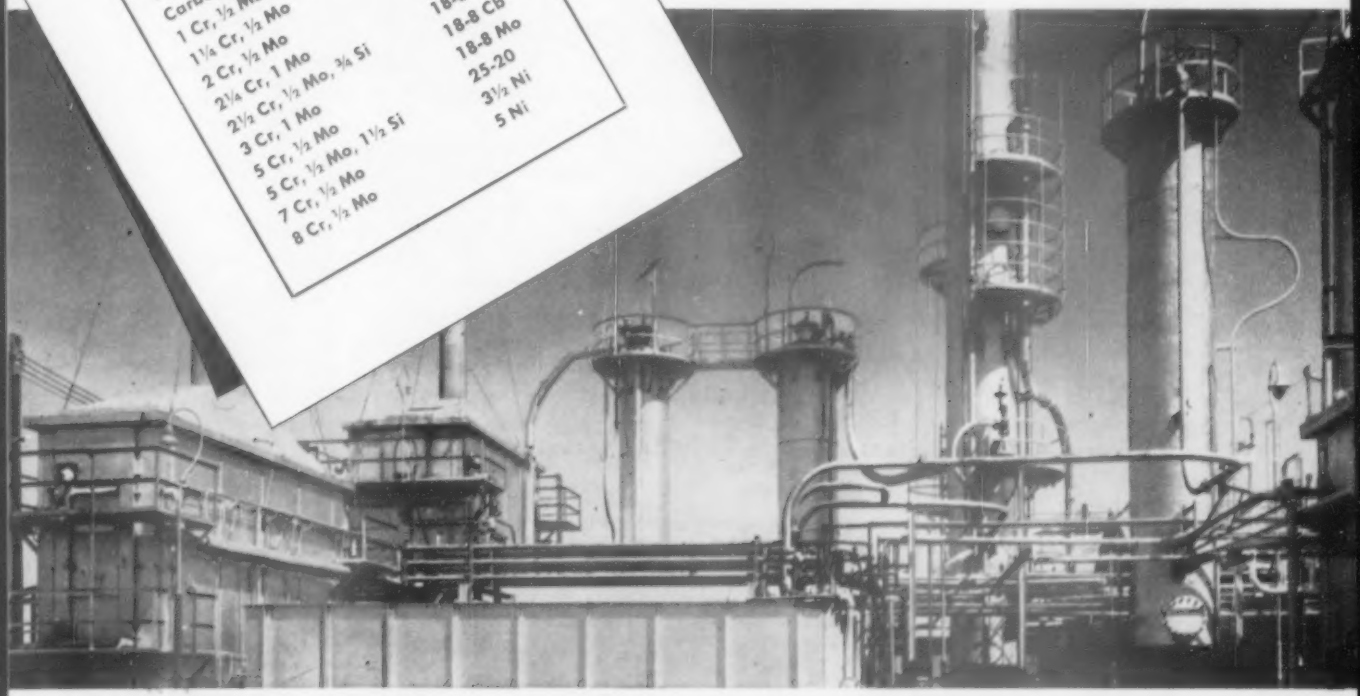
Carbon, ½ Mo
1 Cr, ½ Mo
1¼ Cr, ½ Mo
2 Cr, ½ Mo
2¼ Cr, 1 Mo
2½ Cr, ½ Mo, ¾ Si
3 Cr, 1 Mo
5 Cr, ½ Mo
5 Cr, ½ Mo, 1½ Si
7 Cr, ½ Mo
8 Cr, ½ Mo
8 Cr, 1 Mo
9 Cr, 1 Mo
12 Cr
12 Cr, Al
17 Cr
18-8
18-8 Ti
18-8 Cb
18-8 Mo
25-20
3½ Ni
5 Ni

National Tube Division, United States Steel Corporation, Pittsburgh, Pa.
(Tubing Specialties)

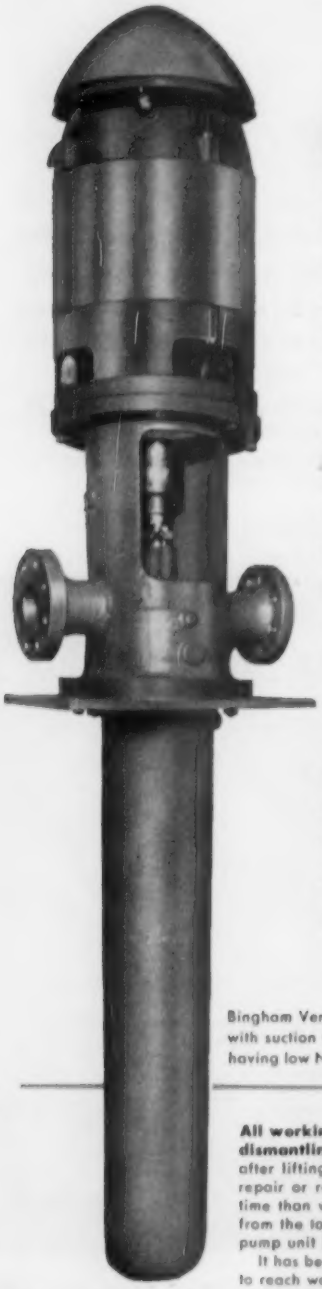
COLUMBIA-GENEVA STEEL DIVISION, SAN FRANCISCO, PACIFIC COAST DISTRIBUTORS
UNITED STATES STEEL EXPORT COMPANY, NEW YORK



USS **NATIONAL SEAMLESS PIPE AND TUBES** SEAMLESS WITHOUT WELDS

UNITED STATES STEEL

NEW! Bingham ALL WORKING PARTS

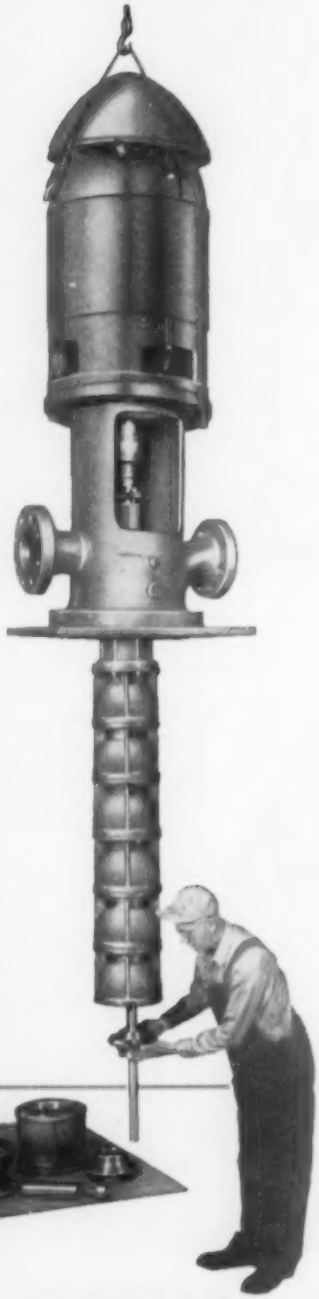


Bingham Vertical VCP assembled with suction well for installations having low NPSH conditions.

Besides bottom dismantling, which in itself greatly reduces maintenance time when attention is required, this new Bingham pump incorporates advanced design features which minimize maintenance, reducing the need for periodic inspection.

For example, all intermediate bearings (supplied of appropriate material for different pumpages) are forced-lubricated by the pumpage. Diagram at right shows this feature and, in addition, shows how bottom bearing is lubricated even if the pump runs dry for short periods. This *dependable* lubrication greatly prolongs the life of bearings, which in conventional pumps are frequently the cause of maintenance shutdowns.

Wherever it has been installed, the new Bingham VCP Pump has given trouble-free service—plus unsurpassed smooth operation with no vibration. Available for any capacity or head. Write your nearest Bingham office for additional information.



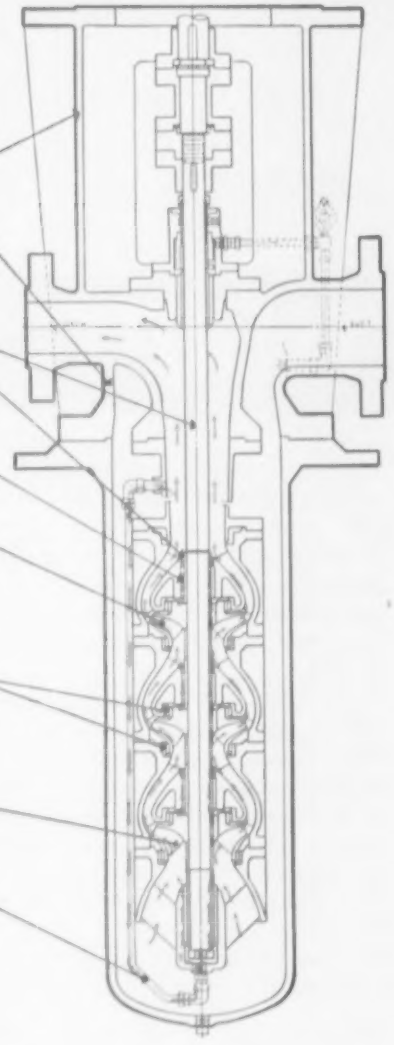
All working parts of pump easily accessible with bottom dismantling. One man can service the Bingham VCP Pump after lifting pump from well. By dismantling from the bottom, repair or replacement of any part can be made in much less time than with conventional pumps (where dismantling begins from the top, necessitating removal of driver and head before pump unit is accessible).

It has been estimated by various operators that time required to reach working parts has been reduced as much as 50%.

VCP VERTICAL PUMP FOR LOW NPSH
ACCESSIBLE WITH BOTTOM DISMANTLING

ONLY *Bingham* OFFERS ALL THESE BENEFITS:

1. Heavy-duty steel suction and discharge head rigidly built to eliminate vibration caused by drivers.
2. Shaft is maximum diameter throughout.
3. Shafts are equipped with renewable 11-13 chrome, hardened, ground and polished sleeves at each bearing.
4. Bearings are of the appropriate material for the different pumpages.
5. Maximum head per stage and maximum efficiency for a given capacity range.
6. Front and back wearing rings on enclosed type impellers permit a one-stage pressure drop over each bearing for lubrication purposes.
7. Wear rings reduce thrust of rotating element, permitting use of standard motors.
8. Maximum eye area of bottom impeller for lowest possible NPSH.
9. Bottom bearing lubricated by pumpage taken from the discharge column, which, together with connecting pipe, acts as a reservoir for bearing lubrication in event pump operates "dry" for short periods.



Bingham SINCE 1921

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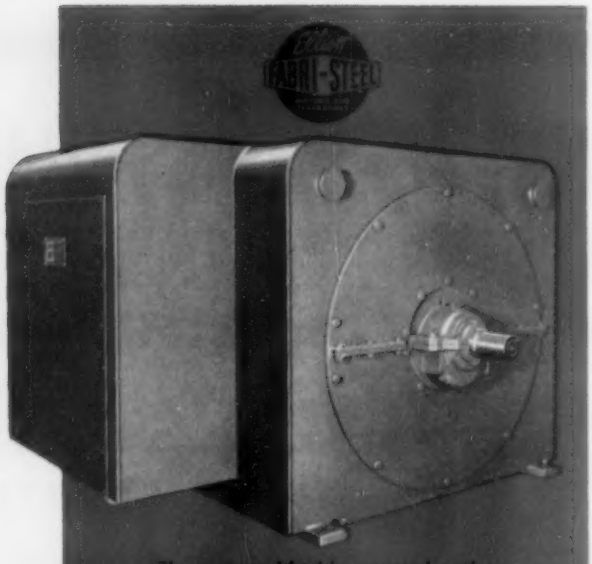
The economical selection for large motor installations in Class I Division II locations...



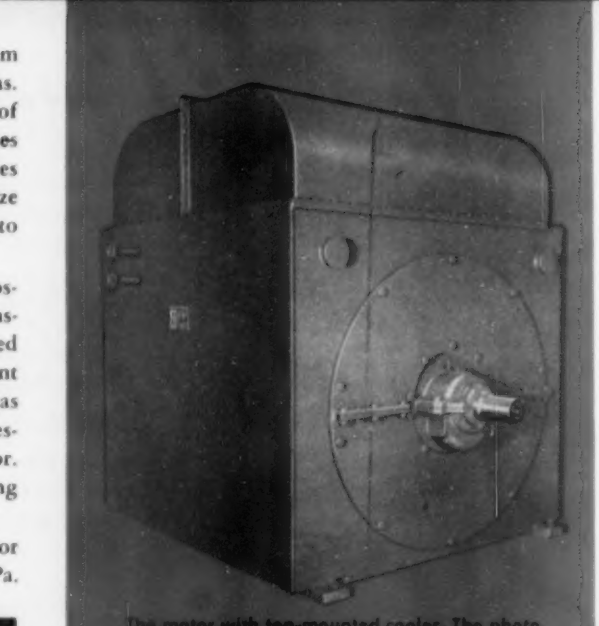
The motor with side-mounted cooler.

ELLIOTT INERT-GAS OR INSTRUMENT-AIR-COOLED MOTORS

These motors are the modern answer to the problem of motor installations above 900 hp in hazardous areas. They represent a substantial saving over the cost of explosion-proof design, the saving in the larger sizes approaching 30%. Furthermore in comparable sizes they provide greater overload capacity, and their size range well exceeds explosion-proof types, going to 4000 hp.

Elliott "Fabri-Steel" construction makes it readily possible to supply these motors in both the types illustrated. The design is basically that of a totally-enclosed water-cooled motor, filled with inert gas or instrument air at .15 psig. Special seals on the shaft prevent gas leakage. Standard equipment includes indicating pressure gauge, low pressure alarm, and pressure regulator. Also, for inert gas, manifold and wall mounting brackets for gas bottles.

Your local Elliott field engineer has full details, or write Elliott Company, Ridgway Division, Ridgway, Pa.



The motor with top-mounted cooler. The photo shows the Elliott squirrel-cage induction motor. Also available in synchronous design.

ELLIOTT Company

R4-6

TURBINE-GENERATORS TURBINES MOTORS GENERATORS DEAERATING HEATERS EJECTORS CONDENSERS COMPRESSORS TURBOCHARGERS TUBE CLEANERS STRAINERS

THESE MIDWEST "LONG TANGENT" ELBOWS SAVED $4121 IN PIPE

MIDWEST "LONG TANGENT" ELBOWS COST NO MORE THAN OTHER ELBOWS

Here are 1227 Midwest "Long Tangent" Elbows (12", 14" and 16" standard weight) ready for shipment to a chemical plant. Each Midwest "Long Tangent" Elbow has a straight section on each end equal in length to ¼ the nominal pipe size. Thus a 12" elbow saves 6" of 12" pipe while a 16" elbow saves 8" of 16" pipe. It doesn't take long to save a lot of pipe and a lot of money . . . in this instance $4121.

But saving pipe is not the only advantage of Midwest "Long Tangent" Elbows. They often eliminate short nipples and their extra welds . . . save time and money in lining up and clamping pipe and fittings . . . slip-on flanges are more easily applied. For all the facts, write for Catalog 54.

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MIDWEST WELDING FITTINGS Improve Piping Design and Reduce Costs

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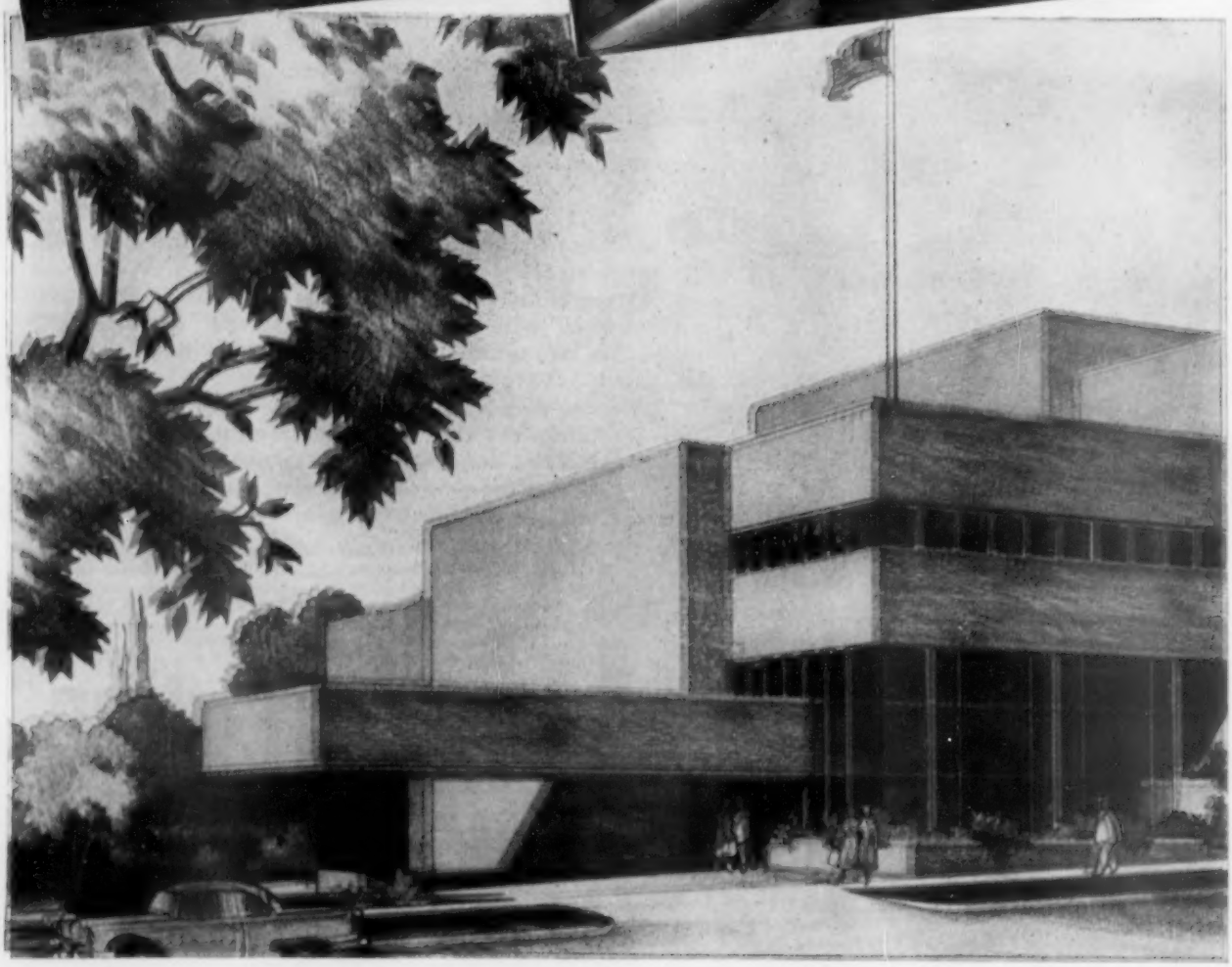
Flow Testing Section for
Capacity and Performance



to Serve You Better. . .

Fisher Governor Company has built the industry's most modern and completely equipped engineering, research and administration building.

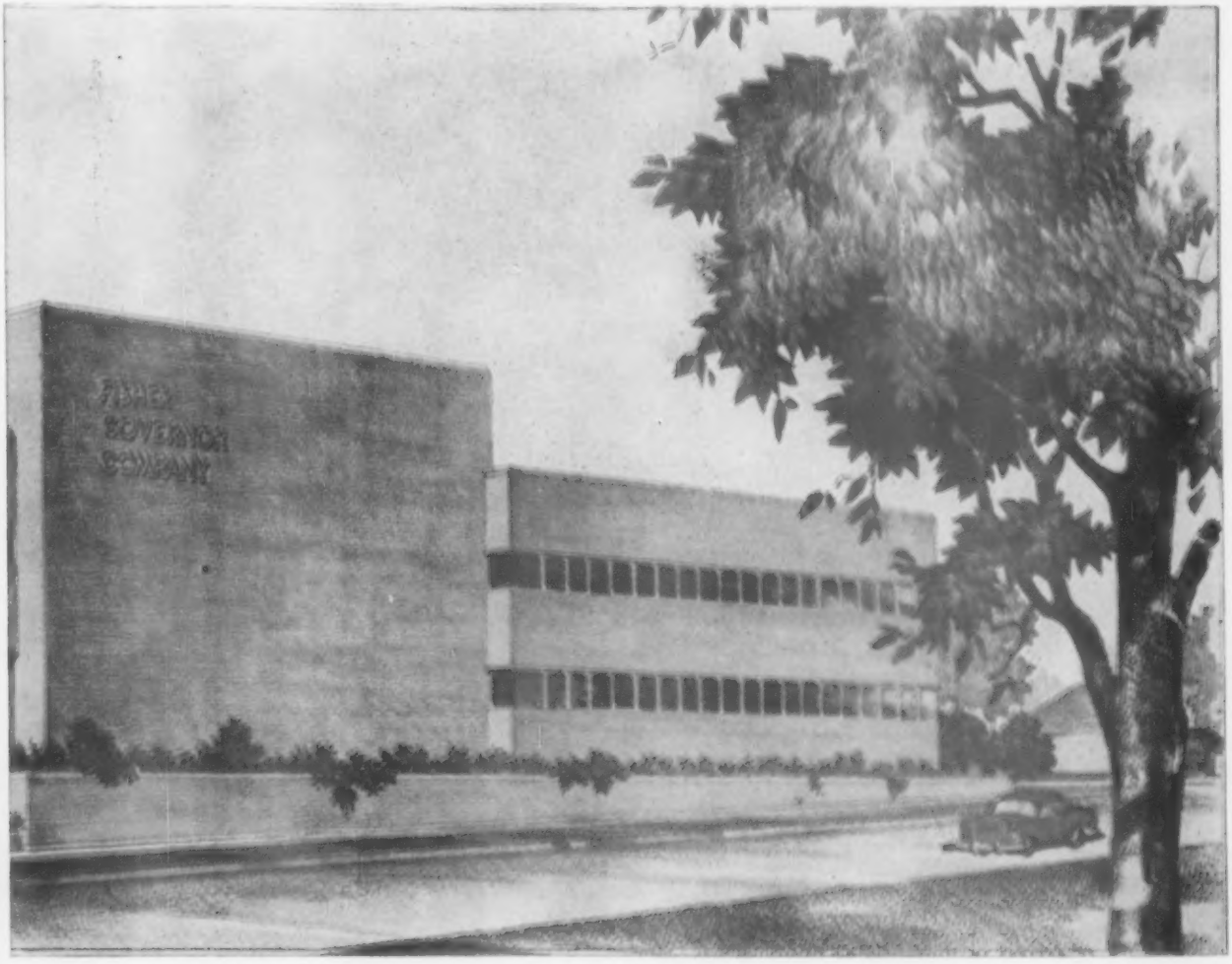
These new facilities—occupying over 100,000 square feet of space—make possible better coordination and greatly expanded engineering and research activities, so as to provide you the world's finest automatic control equipment. A series of test lines up to 12" diameter are located in the research laboratory. Performance tests are run on Fisher products at pressures up to 2500 psi, using air or water as flowing medium.

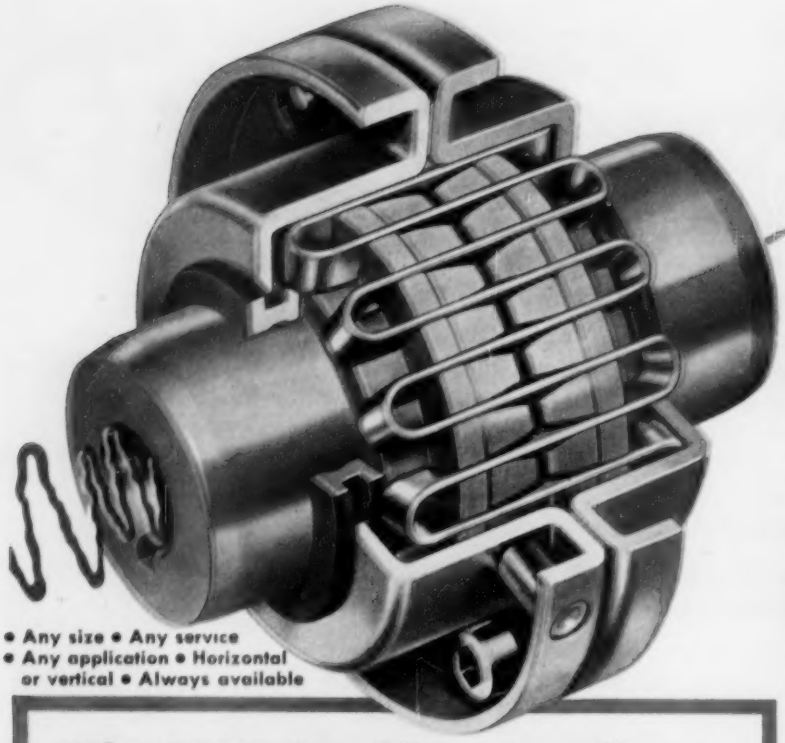
The enlarged product engineering department is located adjacent to the research laboratory area. Sales engineering and administrative offices are also in the new building.

FISHER GOVERNOR COMPANY • MARSHALLTOWN, IOWA

CANADIAN PLANT: WOODSTOCK, ONTARIO

WORLD LEADER IN RESEARCH FOR BETTER PRESSURE AND LIQUID LEVEL CONTROL

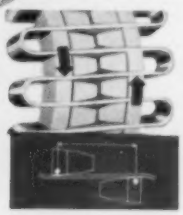




• Any size • Any service
• Any application • Horizontal or vertical • Always available

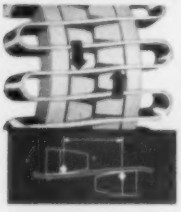
Exclusive FALK Steelflex grid-groove design smothers shock and vibration.

The damaging effects of shock and vibration can shorten the life of any connected machinery. Here is how the Steelflex grid-groove design overcomes these common enemies.



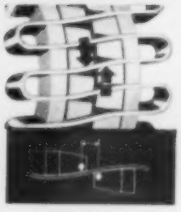
Under LIGHT LOADS

The gridmember bears only at outer edges of grooves. The long span between points of contact remains free to flex under load variations.



Under NORMAL LOADS

As load increases, the distance between supports on the grooves is shortened proportionately, but a free span remains to cushion shock loads.



Under SHOCK LOADS

Under extreme overloads, the grid-member bears fully on the grooves and transmits full load directly. The coupling remains flexible, within its rated capacity.

Why FALK Steelflex Couplings give the *finest* protection for connected machinery

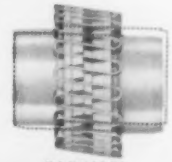
Maximum protection of connected machinery is best provided by Falk Steelflex Couplings because, thanks to their exclusive design, they overcome the damaging conditions of shock loads, shaft misalignment and vibration. How this unique multiple protection is made possible is shown at the right.

Falk Steelflex Couplings give the most economical protection, too, because they make connected machinery last longer and give better service. Furthermore, when actual coupling costs are figured per year of service, Falk Steelflex Couplings show substantial savings through their rugged all-steel construction, easy interchangeability and low maintenance requirements.

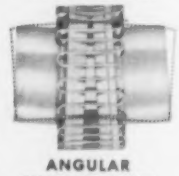
The basic Type F Steelflex Coupling—in 33 sizes to cover capacities from 2/5 through 70,000 hp per 100 rpm—meets over 90% of all industrial applications. Special or Dual Purpose Steelflex Couplings are available for problem applications. Write to Department 247 for engineering bulletin, including selection and dimension details.

...Accommodates shaft misalignment and free end float

Basic maintenance procedure dictates regular inspection and correction of shaft alignment. Between inspections, Steelflex couplings provide protection by accommodating unavoidable shaft misalignment and end float. The gridmember which connects the two hubs of a Steelflex coupling is not fastened to either hub, so each hub can shift without imposing load on the other shaft.



PARALLEL MISALIGNMENT



ANGULAR MISALIGNMENT

FREE END FLOAT

THE FALK CORPORATION, Milwaukee 8, Wisconsin

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- Speed Reducers
- Flexible Couplings
- Shaft Mounted Drives
- High Speed Drives
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42 RIGS

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No matter what depth or location your program calls for, Penrod has the equipment, the skilled men, the experience, to offer you big savings.

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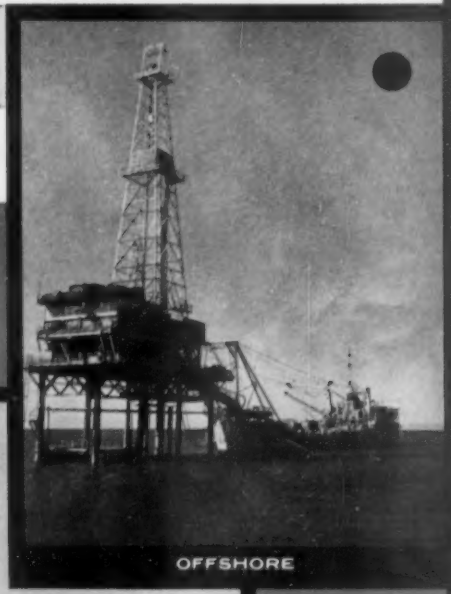

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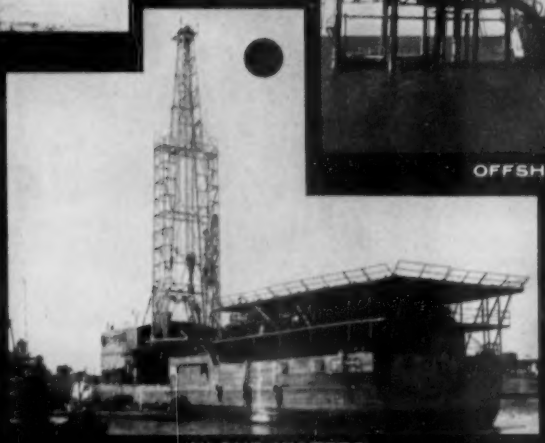
USE OF MAXIMUM DRILL COLLAR WEIGHT



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CONTINENTAL RED SEALS for Performance—Economy—Long Life

GASOLINE AND LPG ENGINES

Model	Cyl.	Bore	Stroke	Displ.	Bare Engine H.P.
N56	4	2¼	3½	56	14.4 @ 2200 RPM
N62	4	2⅜	3½	62	15.3 @ 2200 RPM
Y69	4	2½	3½	69	21.4 @ 2400 RPM
Y91	4	2⅞	3½	91	28.5 @ 2400 RPM
Y112	4	3 5/16	3½	112	32.0 @ 2400 RPM
F124	4	3	4⅛	124	36.5 @ 2400 RPM
F140	4	3 5/16	4⅛	140	42.0 @ 2400 RPM
F162	4	3 7/16	4⅛	162	49.0 @ 2400 RPM
F186	6	3	4⅛	186	60.5 @ 2400 RPM
F209	6	3 5/16	4⅛	209	68.0 @ 2400 RPM
F226	6	3 5/16	4⅛	226	73.0 @ 2400 RPM
F244	6	3 7/16	4⅛	244	79.0 @ 2400 RPM
M271	6	3⅜	4⅛	271	86.2 @ 2400 RPM
M290	6	3¼	4⅛	290	92.2 @ 2400 RPM
M330	6	4	4⅛	330	104.4 @ 2400 RPM
M363	6	4	4 15/16	363	128.9 @ 2800 RPM
B371	6	4⅛	4⅜	371	110.0 @ 2400 RPM
B427	6	4 5/16	4⅛	427	127.0 @ 2400 RPM
G134	4	3⅛	4⅛	134	34.0 @ 2000 RPM
G157	4	3⅛	4⅛	157	40.2 @ 2000 RPM
E201	4	3⅜	4⅛	201	65.4 @ 2400 RPM
H227	4	3⅜	5½	227	54.5 @ 1800 RPM
H243	4	3¼	5½	243	58.0 @ 1800 RPM
H260	4	3⅜	5½	260	62.2 @ 1800 RPM
H277	4	4	5½	277	66.4 @ 1800 RPM
K363	6	4	4 15/16	363	123.0 @ 2400 RPM
J382	4	4½	6	382	74.0 @ 1400 RPM
T371	6	4⅛	4⅜	371	119.0 @ 2400 RPM
T427	6	4 5/16	4⅛	427	140.0 @ 2400 RPM
U501	6	4½	5¼	501	159.0 @ 2400 RPM
R513	6	4½	5⅛	513	164.3 @ 2400 RPM
R572	6	4¾	5⅛	572	182.4 @ 2400 RPM
R602	6	4⅞	5⅛	602	191.7 @ 2400 RPM
V603	8	4⅛	4¼	603	220.0 @ 2800 RPM
S749	6	5⅛	5½	749	217.0 @ 2200 RPM
S820	6	5⅛	5½	820	237.0 @ 2200 RPM

CUSHIONED POWER DIESEL ENGINES

Model	Cyl.	Bore	Stroke	Displ.	Bare Engine H.P.
ZD129	4	3¼	3⅞	129	34.0 @ 2000 RPM
GD157	4	3⅛	4⅛	157	39.0 @ 2000 RPM
*ED201	4	3⅜	4⅛	201	45.8 @ 2000 RPM
HD243	4	3¼	5½	243	55.0 @ 2000 RPM
*HD260	4	3⅜	5½	260	59.0 @ 2000 RPM
*HD277	4	4	5½	277	63.0 @ 2000 RPM
*JD382	4	4½	6	382	72.5 @ 1600 RPM
TD427	6	4 5/16	4⅞	427	106.0 @ 2000 RPM
RD572	6	4¾	5⅛	572	154.0 @ 2000 RPM
VD603	8	4⅛	4¼	603	175.0 @ 2600 RPM
SD802	6	5 5/16	5½	802	202.0 @ 1800 RPM

*Available for industrial applications only.

One reason for the oil field's widening acceptance of Red Seal power is the diversification of the Red Seal line. Long-range satisfaction with any piece of equipment depends largely on the closeness with which the engine is matched to its work. And with 47 different basic models from which to choose—each capable of still closer tailoring to the job's specific needs, through specification changes—your requirements can be met exactly, no matter what the application.

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Continental Motors Corporation

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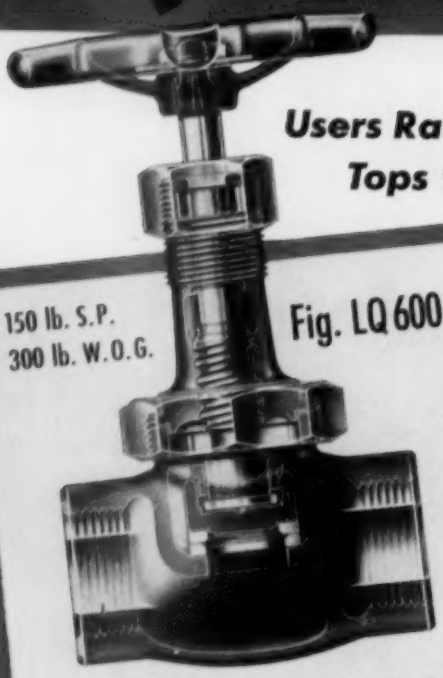
LQ600 STOPS VALVE LEAKS!

Users Rate New Lunkenheimer LQ600 Valve Tops for Maintenance-Free Service



150 lb. S.P.
300 lb. W.O.G.

Fig. LQ600

These are actual case-history reports, typical of the amazing performance records being set by LQ600 Globe valves in severe-service applications everywhere . . .

● "LQ600 has been outstandingly successful on our toughest services. We are going to use LQ600 in all future globe valve replacements and new installations."

● "It begins to look as though 'wire drawn' seats and plugs are obsolete now. We've been on the lookout for a valve like LQ600 for years, so we're suggesting that all our branches get a supply and replace all leakers immediately."

● "Previous valves were lasting only two weeks to two months before the stainless steel seats and discs had to be replaced. Your LQ600 has been holding since May 1, 1953."

● "LQ600 has 'stayed put' on this tough service since 1952, where both plug and composition disc valves gave trouble for years. It's the only valve that ever held on this service."

● "We have a severe 120 lb. steam throttling service, and regular plug valves lasted only about a week before leakage. Not one of your LQ600 Valves has leaked in this service, and we are now using them all over the plant, in all sizes."

IF YOU NEED GLOBE VALVES THAT DO NOT LEAK, AND YOU WANT TO ELIMINATE SEAT AND DISC REPAIRS—

USE LQ600

WRITE FOR CIRCULAR 602 The Lunkenheimer Co., Cincinnati 14, O.

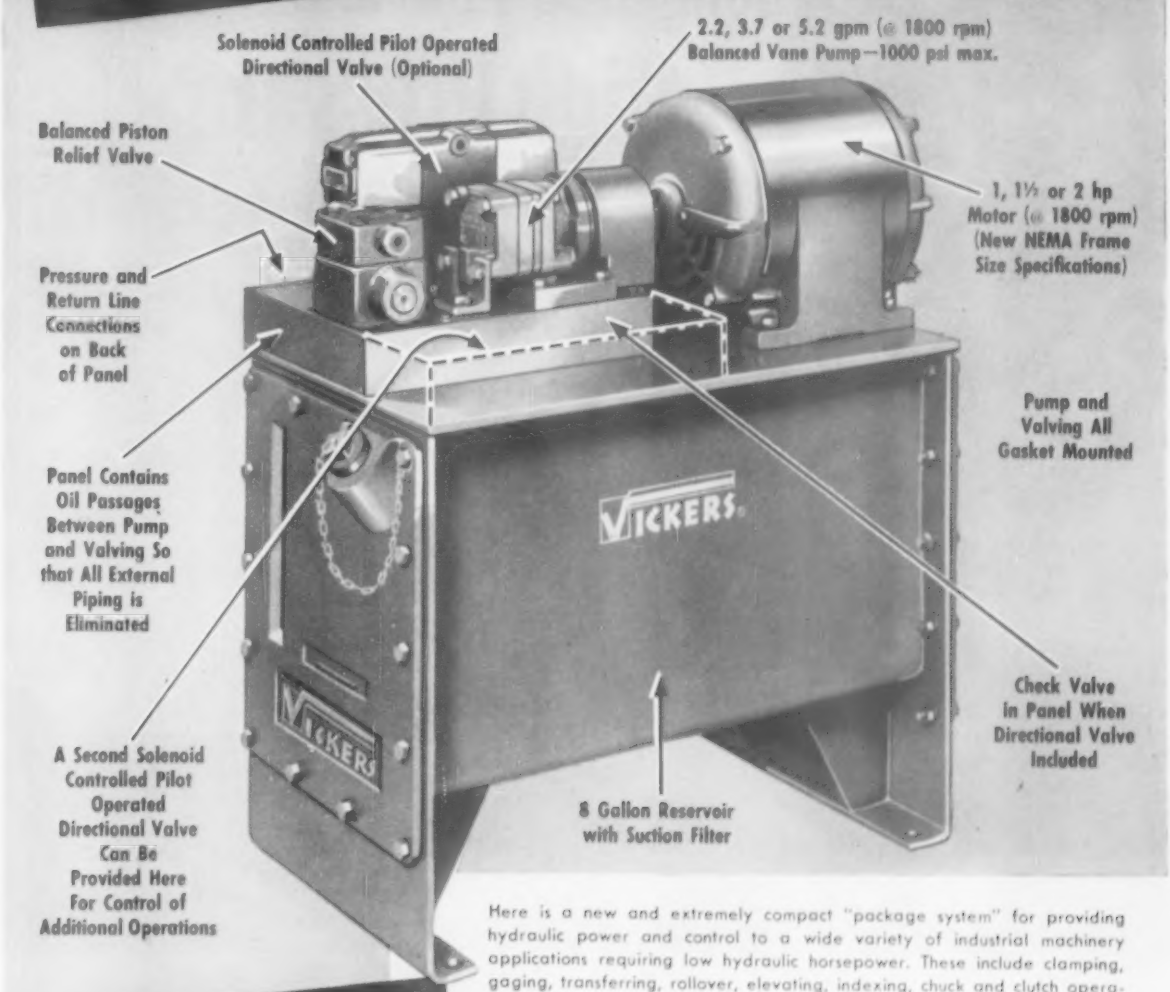
STEEL • IRON • BRONZE • PVC

LUNKENHEIMER®

THE ONE *Great* NAME IN VALVES

L-1155-75

A NEW IDEA . . . in hydraulic power and control systems


Solenoid Controlled Pilot Operated Directional Valve (Optional)
2.2, 3.7 or 5.2 gpm (@ 1800 rpm) Balanced Vane Pump—1000 psi max.
Balanced Piston Relief Valve
1, 1½ or 2 hp Motor (@ 1800 rpm) (New NEMA Frame Size Specifications)
Pressure and Return Line Connections on Back of Panel
Pump and Valving All Gasket Mounted
Panel Contains Oil Passages Between Pump and Valving So that All External Piping is Eliminated
VICKERS
Check Valve in Panel When Directional Valve Included
A Second Solenoid Controlled Pilot Operated Directional Valve Can Be Provided Here For Control of Additional Operations
8 Gallon Reservoir with Suction Filter

Here is a new and extremely compact "package system" for providing hydraulic power and control to a wide variety of industrial machinery applications requiring low hydraulic horsepower. These include clamping, gaging, transferring, rollover, elevating, indexing, chuck and clutch operations, etc.

Note the many features indicated on the photograph above. The result is improved and simplified hydraulic design . . . also reduced installation and maintenance costs. This "package system" has great flexibility . . . is available in a wide variety of combinations of standard components assembled to suit individual requirements. Pretested and ready for immediate operation, it has also the advantage of undivided Vickers responsibility. For further information, ask for installation drawings 178706-8.

VICKERS

Series T8 HYDRAULIC PIPELESS POWER PACKAGE

7311

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DIVISION OF SPERRY RAND CORPORATION

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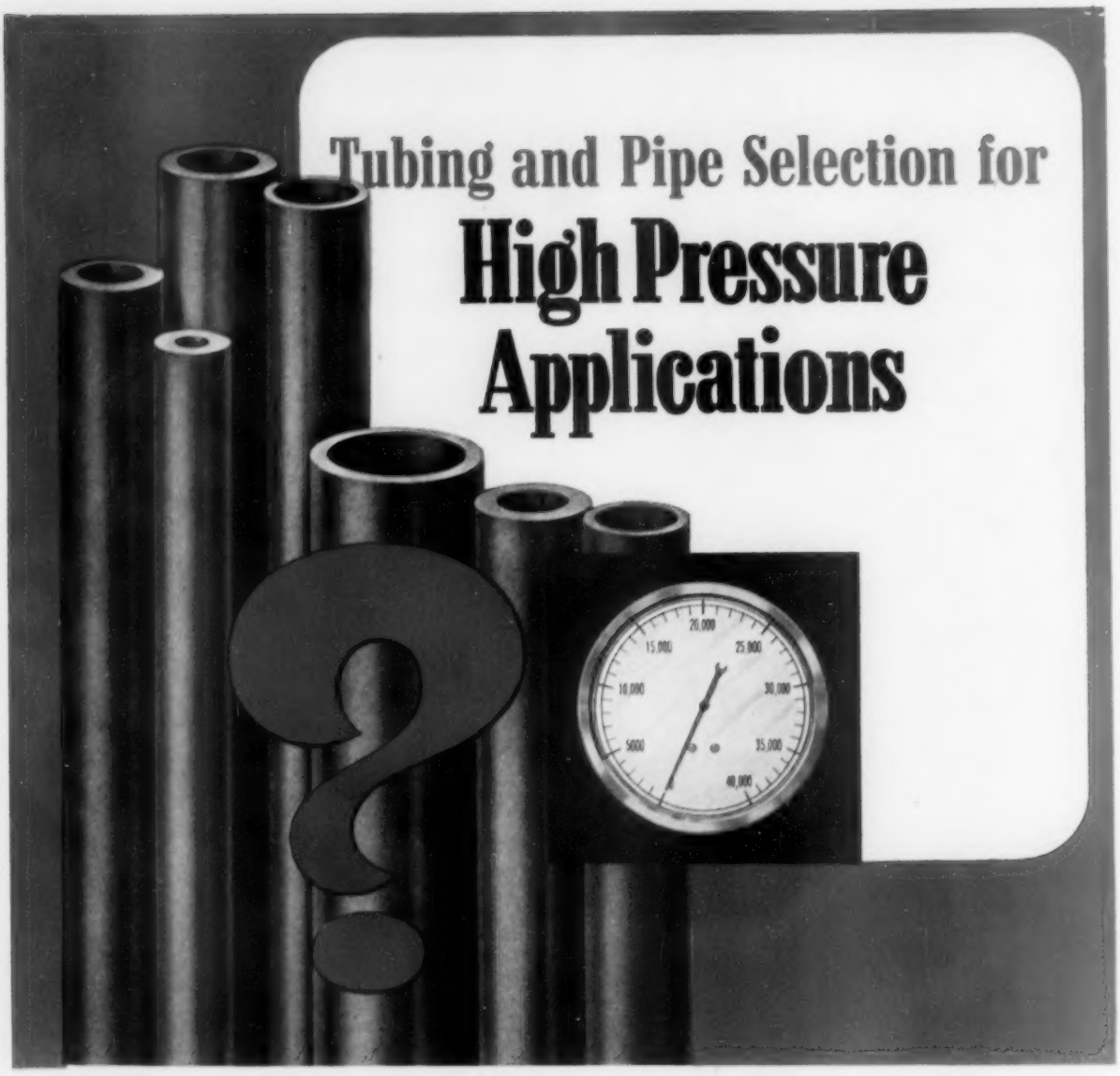
IN CANADA: Vickers-Sperry of Canada, Ltd., Toronto

*These "package systems" supplement the Vickers line of standard hydraulic power units.

ENGINEERS AND BUILDERS OF OIL HYDRAULIC EQUIPMENT SINCE 1921

Tubing and Pipe Selection for High Pressure Applications



Specific working pressure is one of the major considerations in the choice of tubing or pipe for a given fluid-handling application. To obtain optimum efficiency and economy, however, it is necessary to consider temperature conditions, tube size, mechanical strength of the steel, and corrosion hazards.

A case in point that clearly shows the complexity of selecting the right tubing for pressure applications involved the installation of a stabilized stainless steel to carry methanol and unreacted synthesis gases at 300 F and 5000 psi while being exposed to chloride-bearing bayou water. This exposure caused pitting corrosion which, in turn, localized the pressure stresses at the roots of the pits causing, eventually, failure by stress corrosion. To effectively solve this costly problem, B&W with its long experience in all phases of tubing applications, helped in selection of B&W Croloy 5. This choice provided increased resistance to the pitting while meeting the temperature and pressure factors satisfactorily *and at a substantial savings in material cost.*

It takes an expert to specify the optimum tubing or pipe for any particular application. And there is no substitute for the kind of experience with such problems that you will find at B&W. To get the most benefit from B&W's long experience in matching tubes and piping to jobs—call on Mr. Tubes, your nearby B&W Tube Representative. *Or write for Bulletin 6.*

B&W
TUBULAR PRODUCTS DIVISION

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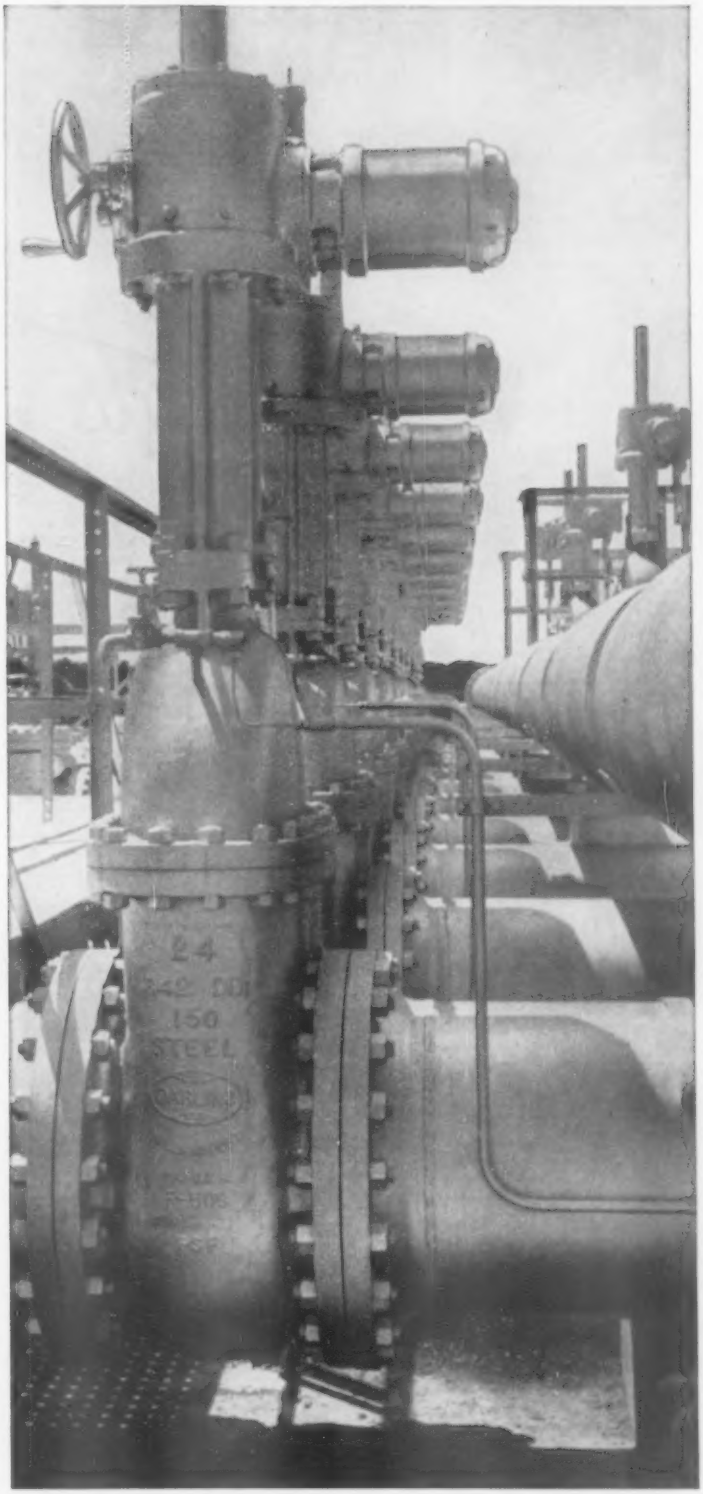
TA-5058-P



DARLING VALVES

How to line up a *cost-important* principle

THESE Darling gate valves have one thing in particular no other gate valves can match—Darling's *fully revolving double disc, parallel seat principle.*

What does this mean?

Skipping to end results . . . smoother, easier valve operation . . . automatic compensation for valve body distortion to assure tight closure . . . and avoidance of wear concentration areas on both discs. In turn all this just naturally adds up to longer valve life, surer performance, less maintenance, less part replacement, less down time, and lower over-all operating cost.

These gains are a matter of record—the real reason why Darling valves today are picked for so many oil and gas line jobs. Give us an idea of your service needs and get complete, specific details on the Darling valves that can do the *best* kind of a job for you!

Line-up of Darling 24" motor-operated steel gate valves at a major crude oil pumping station. Here, as elsewhere, Darling's fully revolving double disc feature pays off.

DARLING VALVE & MANUFACTURING CO.

Williamsport 1, Pa.

Manufactured in Canada by Sandilands Valve Manufacturing Co., Ltd., Galt 19, Ontario

Catalysts

Require stability, too . . .

and with Davison's *LOW DENSITY* catalyst you get commercially proven higher stability. You get a higher degree of thermal stability without affecting the resistance to attrition or other proven qualities of Davison catalysts. Commercial fluid cracking units, operating for over one year, demonstrate that this stability leads to:

Higher surface area—Higher pore volume—Higher pore diameter—Higher catalytic activity—Improved regeneration

This new *LOW DENSITY* catalyst is yet another Davison catalyst manufactured with controlled catalyst characteristics. At Davison you can get the catalyst best suited for your unit. For information on Davison's new *LOW DENSITY* catalyst, as well as other Davison catalysts, see your Davison representative or write.

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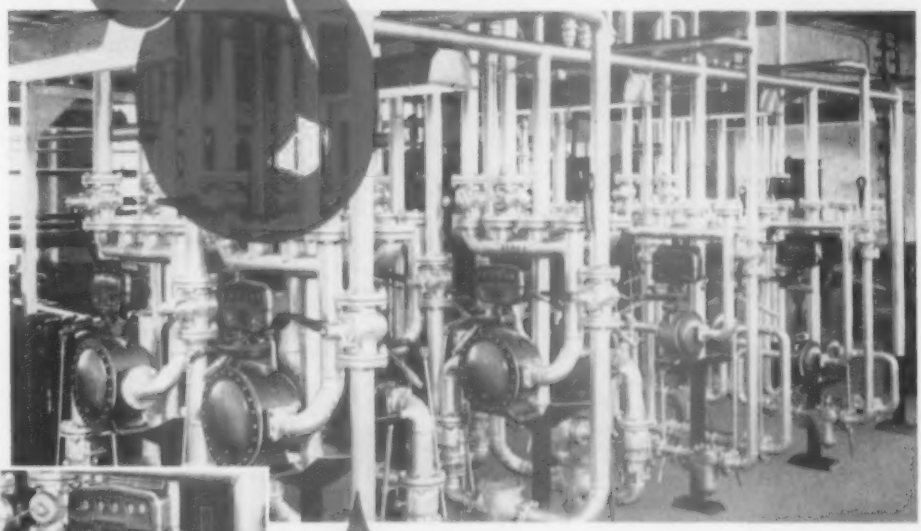
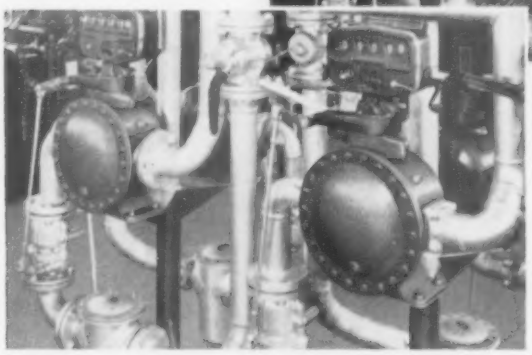
Blending Lube Oils

IN JUST 1/4 THE TIME

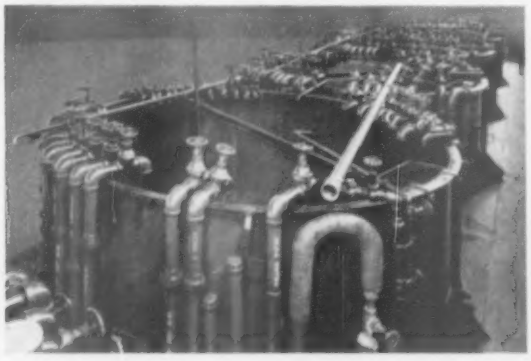


16 Brodie BiRotor Meters at Standard Oil Company of California's Richmond Blending Plant are manifolded to a battery of tanks holding over 20,000 gallons each.

BiRotor Meters with Brodie Slow-Closing "Quantrol" valves give shock-free shut-off at exact pre-determined gallonage.



Conventional blending tanks in foreground illustrate complex valve, piping and measuring equipment replaced by automatic metering system.



with BRODIE *BiRotor* METERS

20,000 gallons blended in 1 hour . . .

. . . contrasted to 4 hours required by stick measure method

- Over 18 million gallons handled without meter maintenance
- Printed meter tickets keep verified record of base stocks and additives blended in each batch
- Uniform accuracy assured by automatic "Quantrol" shut-off of exact quantity of each component delivered to mixing tank

In this modern blending installation, 16 Brodie BiRotor Meters in a simple manifolded system with a single header replace thousands of feet of pipe and hundreds of valves formerly required to serve the many blending tanks. Quick pre-setting of "Quantrol" valves at central meter manifold, and a single valve at the blending tank, are all that is required. Human error and time consuming stick measurement of manual operation are eliminated. All components flow simultaneously, further reducing blending time. For lower cost installation and operation with maximum accuracy and minimum maintenance, investigate Brodie BiRotors for product blending operations.

BRODIE BiRotor METERS

ALL-STEEL TRUE-ROTARY

RALPH N. BRODIE COMPANY · San Leandro, California, U.S.A.

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What makes a cylindrical roller bearing good?

RETAINERS

"requirement-engineered" for your kind of service

The basic parts of a roller bearing are the rollers, the races, and the *retainer* which locates and guides the rollers. There are significant differences in the design and construction of retainers, which influence bearing cost and performance. Some are simple and economical, well adapted for volume production; others are more costly but insure improved roller guidance, or cooler and smoother operation, or longer heavy-duty service. Here are the seven basic types in current use.

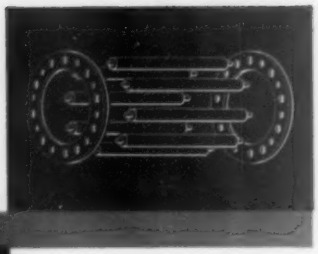
HYATT MAKES ALL SEVEN TYPES . . . EACH THE FINEST OF ITS KIND! You will find complete details in HYATT General Catalog No. 150, or your nearby HYATT Sales Engineer will gladly help you choose the type best suited to your requirements. Remember, HYATT is America's *first* and *foremost* maker of cylindrical roller bearings. Hyatt Bearings Division of General Motors, Harrison, New Jersey.

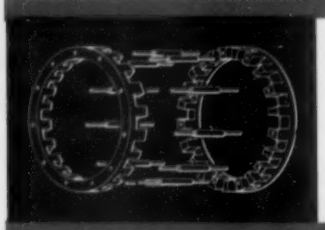
GM GENERAL MOTORS

HYATT

ROLLER BEARINGS

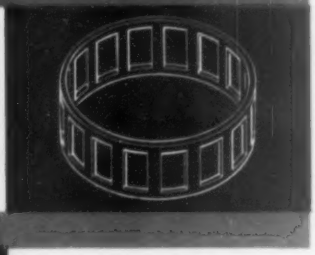
TRUNNIONED ROLLER CAGE—Economical for volume use on thin-annulus bearings. End rings are hardened steel stampings, connected by riveted bars interspersed between rollers to form an integral unit. Races can be omitted if desired.

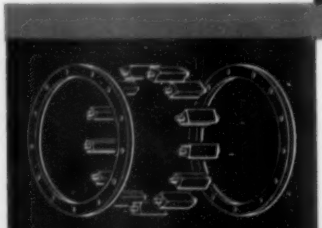




POCKETED END RING CAGE—Designed for fairly large bore bearings in heavy-duty service. Rollers are guided accurately by pockets drilled in bronze end rings. Riveted connecting bars form an integral unit, so races can be omitted if desired.

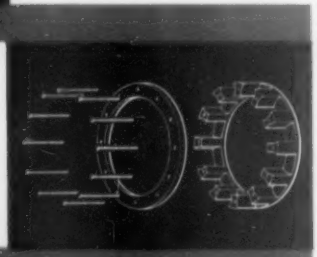
STAMPED STEEL SEPARATOR—Economical for volume use on wide range of bearings with short rollers. A single steel stamping with bars coined to conform to roller contour. Simple, open design assures large lubricant capacity and good circulation.





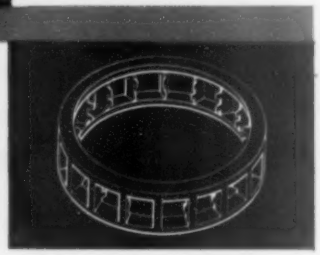
FORMED BAR CAGE—Well adapted for volume use on heavy-duty bearings. Hardened steel end rings are connected by cold-rolled shaped bars conforming to roller diameter. Insures quiet operation, better roller guidance, and the smooth surface of bars protects rollers.

DRILLED POCKET CAGE—Used on better-grade bearings to provide extremely close control of rollers, which operate in pockets drilled and reamed in bronze cylinder. Riveted ring on one end retains rollers permanently, so races may be omitted if desired.



SEPARABLE BROACHED POCKET CAGE—Used only on finest high-speed bearings. An integral bronze cylinder with pockets broached for maximum uniformity. Insures minimum friction, better oil circulation for cooling. Rollers can be removed for inspection.

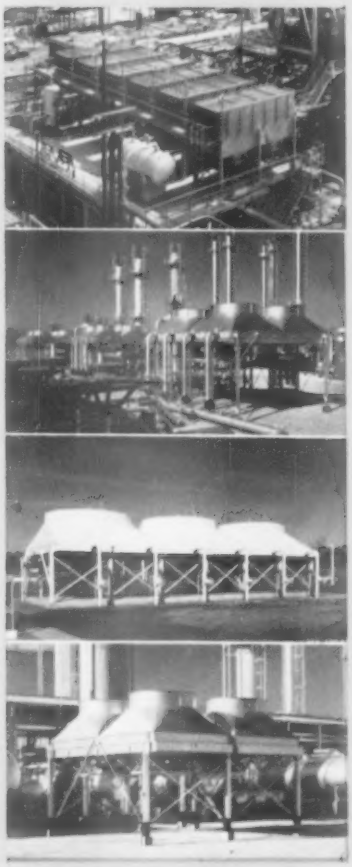
NON-SEPARABLE BROACHED POCKET CAGE—Similar to the above and offers all the same operating advantages. Used for "blind" installations where rollers must be retained with inner or outer race. Roller drop controlled by deforming bars after rollers are placed.



HUDSON LEADS THE WAY
In Equipment For

Cooling with Air

More than 600 HUDSON Solo-aire and Combin-aire Units are giving complete satisfaction both in mechanical operation and in meeting cooling performance specifications in . . .



OIL REFINERIES

Solo-aire Units, installed in space formerly occupied by water box submerged coolers, are used for condensing and oil cooling, eliminating water circulation of 4200 gallons per minute. Previous high maintenance costs due to water scaling and corrosion are also eliminated.

GAS PROCESSING PLANTS

Solo-aire Units as pictured at left, and Combin-aire Units, are minimizing water consumption, lowering water treatment costs, and lowering over-all maintenance expense in scores of Gas Processing Plants in the United States, Europe, Pakistan and South America.

COMPRESSOR STATIONS

Solo-aire Units are installed in many of the larger main line Compressor Stations in the United States for cooling gas, jacket water, and lube oil. HUDSON auto-variable pitch fans allowing accurate, automatic control of cooler outlet temperature are used in many of these installations.

CHEMICAL PLANTS

Vapor at 550°F. is condensed and condensate subcooled in Solo-aire pictured at left. In services for cooling of very high temperature fluids, and cooling of fluids with which water contamination must be avoided, Solo-aires are particularly adapted.

Experience The first HUDSON exchangers using air as the cooling medium were installed over 20 years ago for condensing exhaust steam. Thru constant research, improvement and innovation in design and in manufacturing techniques, and in development of units for special applications, HUDSON reached and has retained its position of leadership in "Cooling with Air."

HUDSON
ENGINEERING CORPORATION

FAIRVIEW STATION • HOUSTON, TEXAS

LARGE POWER SAVINGS
and Accurate, Automatic Temperature Control
with HUDSON AUTO-VARIABLE PITCH FANS

WHY do Hudson Auto-variable pitch fans on Hudson Solo-aire and Combin-aire units not only *give accurate temperature control* of cooled streams, but — *save up to 85% of fan horsepower* compared with conventional fixed pitch fans?

BECAUSE fixed pitch fans are usually selected to move the air required under conditions of summer air temperature and maximum heat load, and needlessly move such maximum quantity even under conditions of winter air temperatures and lower-than-design heat loads. With Hudson Auto-variable pitch fans the blade pitch is automatically controlled by outlet cooled fluid temperature so that only the quantity of air required to maintain this temperature is moved. This quantity in winter may be only 30% of that required in summer, resulting in fan horsepower saving of 85% attributable to Auto-variable pitch fans as compared with conventional fixed pitch fans.

OVER 200 AUTO-VARIABLE PITCH FANS are providing accurate, trouble-free temperature control in Hudson Solo-aire and Combin-aire units. Minute changes in cooled fluid outlet temperature immediately and automatically changes pitch of fan blades, increasing or decreasing flow. Control is effective despite changes in heat load or hot fluid inlet temperature; and over ambient air temperature range of more than 150° F.

Consult Hudson for more detailed information on the application of Auto-variable pitch fans to present or future installations.

HUDSON AUTO-VARIABLE PITCH FANS

- **Accurately control temperature.**
- **Effect major savings in power.**
- **Reduce cost of control equipment.**
- **Eliminate by-pass piping.**
- **Prevent freezing even in extremely cold weather.**
- **Operate with standard pneumatic instruments.**
- **Have all moving parts of control mechanism completely enclosed and weather-proofed.**

HUDSON
ENGINEERING CORPORATION

FAIRVIEW STATION • HOUSTON, TEXAS

J&L can help you with VALVES

We have sold valves for over half a century.

Use this experience! Its practical application by trained J&L men can be valuable to you when problems arise or technical specifications are involved.

In the meantime valves and fittings you need from day to day are in stock at your near-by J&L Store. Good valves, well selected.

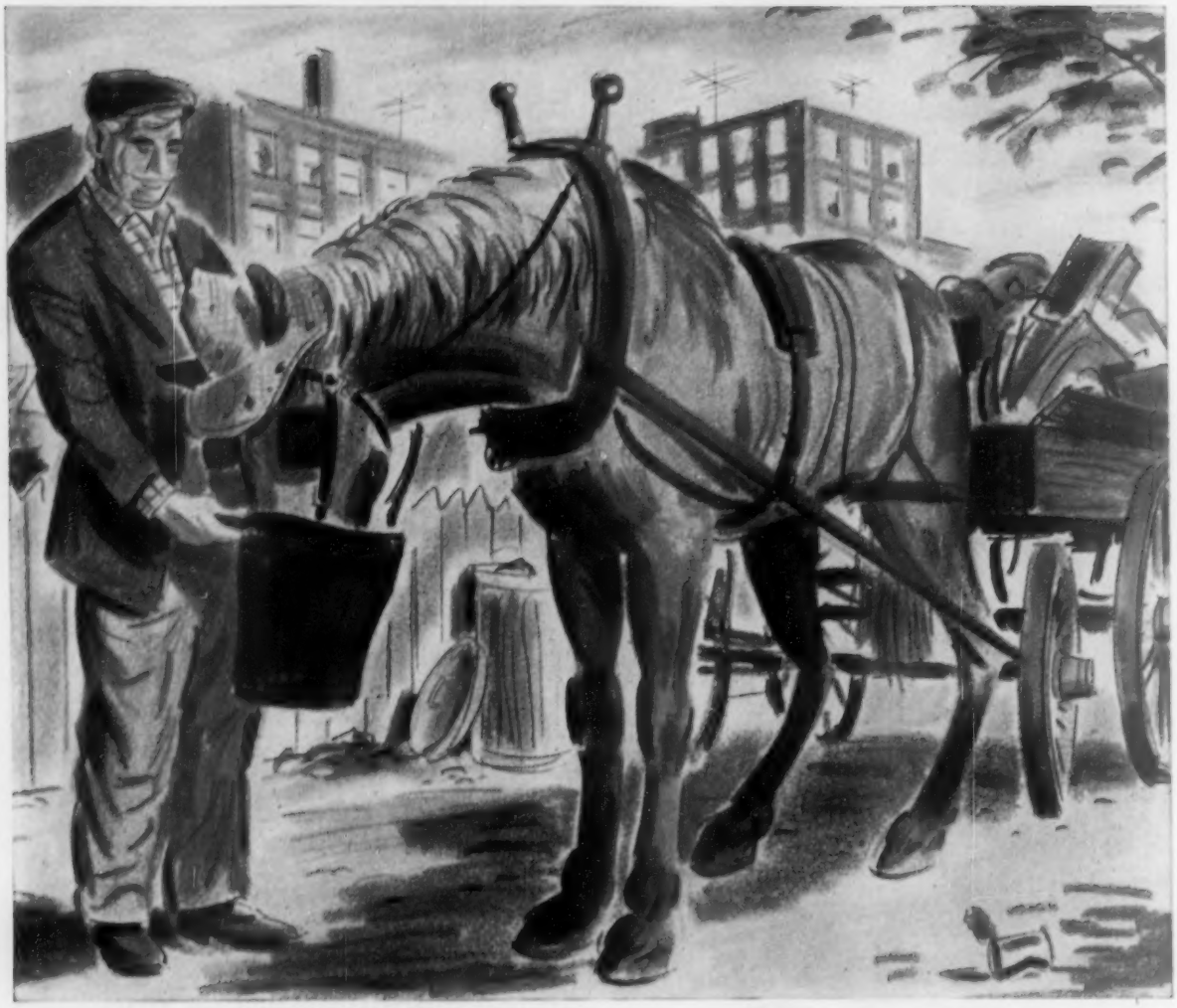
Yes, *J&L can help you with valves.*

Jones & Laughlin

SUPPLY DIVISION – Tulsa

SERVING THE UNITED STATES AND CANADA

6G

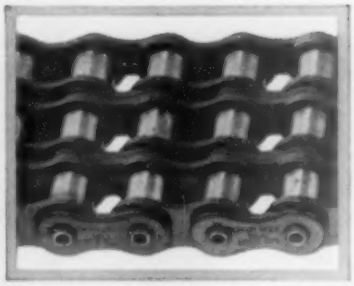


You need longest possible service life in roller chains, too...

You know what down time cost you ...and you know the extra profits you make by the elimination of unnecessary down time! Well, suppose you could get a roller chain that would last longer and eliminate premature failures. And, suppose when you want to take the chain down, it could be taken down and replaced in far less time. Wouldn't that add up to a substantial saving?

That's why you owe it to yourself to investigate Rex Oil Field Roller Chains for your rigs. Because these chains *have* all those time-saving, profit-making features. Revolutionary pitch control system, tremendously strengthened pin holes, top-quality materials, "glide-fit" design that makes assembly and disassembly easy, are among the many reasons why Rex Roller Chains give you the far longer service life you want... help you drill more feet of hole per day and per year. There's no better chain made!

Get the complete story from your supply store, your Rex® Field Sales Engineer, or write directly to CHAIN Belt Company, 4619 W. Greenfield Ave., Milwaukee 1, Wis., for your copy of Catalog No. 55-3.



CHAIN BELT COMPANY

MILWAUKEE 1, WISCONSIN

OIL FIELD OFFICES: DALLAS • HOUSTON • TULSA • MIDLAND • LOS ANGELES • NEW YORK

Pumping Progress Report

FOR PETROLEUM ENGINEERS

An advertisement prepared by the Aldrich Pump Co., Member of Hydraulic Institute, U.S.A.

PUMPING LIQUID BUTANE AND PROPANE is a typical operational headache successfully handled by the Aldrich Pump Company Engineers. It was a particularly tough pumping problem for one large pipe line company; they had to move butane 186 miles — from a Texas oil field to a Gulf Coast refinery.

PUMPING LIGHT-GRAVITY FLUID AT HIGH PRESSURES required the positive displacing action of conventional reciprocating pumps plus the flexibility of capacity provided by centrifugals. And Aldrich Engineers knew the answer — the Aldrich-Groff Controllable Capacity "POWR-SAVR" Pump.

STEPLESS STRAIGHT LINE CONTROL OF CAPACITY, from zero to rated maximum output, was possible with the "POWR-SAVR". Pump delivery was automatically controlled to suit varying requirements and power consumption became nearly proportional to the rate of output, affording desirable power savings.

SURGE TANKS WERE ELIMINATED, due to the "POWR-SAVR's" ability to meet immediate changing line conditions. This eliminated associated evaporation losses, co-mingling of different batches, and much of the danger of handling highly flammable material. Gone, too, was the need for bypassing to handle excess quantities of pump output.

UPRIGHT DESIGN of the "POWR-SAVR" places discharge valves directly over the plungers and inlet valves at one side. Efficient valve action permits the pump to operate at the high rate of 240 rpm. Another design feature was the use of porcelain plungers, reducing packing and leakage troubles.

THE ALDRICH PUMP COMPANY has been solving the difficult pumping problems of American industry since 1902. We've never turned down a challenge — many of yesterday's tough pumping problems are today routine.

DATA SHEET 65A, describing the Aldrich-Groff Controllable Capacity "POWR-SAVR" Pump will be sent to you on request. Or our representative will be glad to call. Address your request to: The Aldrich Pump Company, 9 Gordon Street, Allentown, Pa.

Aldrich-Groff Controllable Capacity "POWR-SAVR" Pump suitable for pumping butane and other light-gravity fluids.

. . . for your tough pumping problems specify ALDRICH

This machine is ideal for pumping light-gravity fluids at medium and high pressures. It combines features of superior efficiency and positive displacing action of reciprocating pumps with the flexibility of capacity of centrifugal pumps. A unique, reliable mechanism controls the plunger-stroke from zero to rated output without change of speed of power source, providing desired savings in power plus top efficiency.

Typical Applications for the Aldrich-Groff "POWR-SAVR" Pump:

Pipe Line Service	Process Charging
Boiler Feeding	Oil-burner Supply

Write for Data Sheet 65A, describing the features of the "POWR-SAVR" Pump. Or, if you prefer, our representative will be glad to call.

THE ALDRICH PUMP COMPANY

Originators of the Direct Flow Pump

9 GORDON STREET

ALLENTOWN, PA.

Representatives in principal cities

This is Why the Nash is the Most Simple Compressor

It's the Nash!

There are no mechanical complications in a Nash Compressor. A single moving element, a round rotor, with shrouded blades, forming a series of buckets, revolves freely in an elliptical casing containing any low viscosity liquid. This liquid, carried with the rotor, follows the elliptical contour of the casing.

The moving liquid therefore recedes from the rotor buckets at the wide part of the ellipse, permitting the buckets to fill with gas from the stationary Inlet Ports. As the casing narrows, the liquid is forced back into the rotor buckets, compressing the gas, and delivering it through the fixed Outlet Ports.

Nash Compressors produce 75 lbs pressure in a single stage, with capacities to 6 million cu. ft. per day in a single structure. Since compression is secured by an entirely different principle, gas pumping problems difficult with ordinary pumps are often handled easily in a Nash.

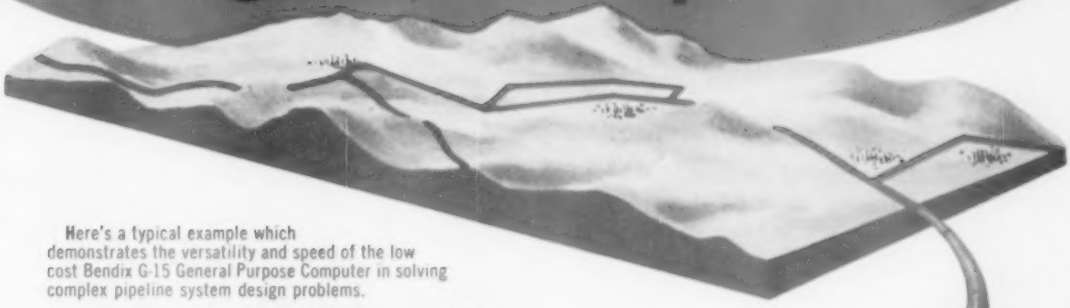
Nash simplicity means low maintenance cost, with original pump performance constant over long periods Data on these pumps sent immediately on request

- No internal wearing parts.
- No valves, pistons, or vanes.
- No internal lubrication.
- Low maintenance cost.
- Saves floor space.
- Desired delivery temperature automatically maintained.
- Slugs of liquid entering pump will do no harm.
- 75 pounds in a single stage.

NASH ENGINEERING COMPANY
313 WILSON, SO. NORWALK, CONN.

GIVES THE ANSWER TO PIPELINE DIFFERENTIAL PRESSURES... IN SECONDS!

Bendix Computer



Here's a typical example which demonstrates the versatility and speed of the low cost Bendix G-15 General Purpose Computer in solving complex pipeline system design problems.

A proposed system of pipelines 160 miles long with 1800 feet variation in altitude, was to consist of a number of pipes of different diameters running in parallel over eleven given sections. At the end of the sections, gas was to enter the flow from another source or be branched off to another destination. In addition, two compressors were to be placed at various sections along the line.

6 SECONDS TO SOLVE EACH STATION

After the problem has been entered into the Computer only 6 seconds per section are required to solve and print the answer for each station, giving pipeline pressure, flow rate of the gas and the mile posts.

In addition, the Computer requires only 8 seconds to provide the following for each compressor calculation: fuel used, brake H.P., sea level H.P., compression ratio, suction pressure and discharge pressure.

The Bendix G-15 is an entirely new concept in electronic computation. Its unusually low cost, large capacity and speed make it an economically sound investment for research, engineering and control functions, even for so-called "small" company operations.

Let us send you complete information on how the Bendix Computer can effectively serve you.

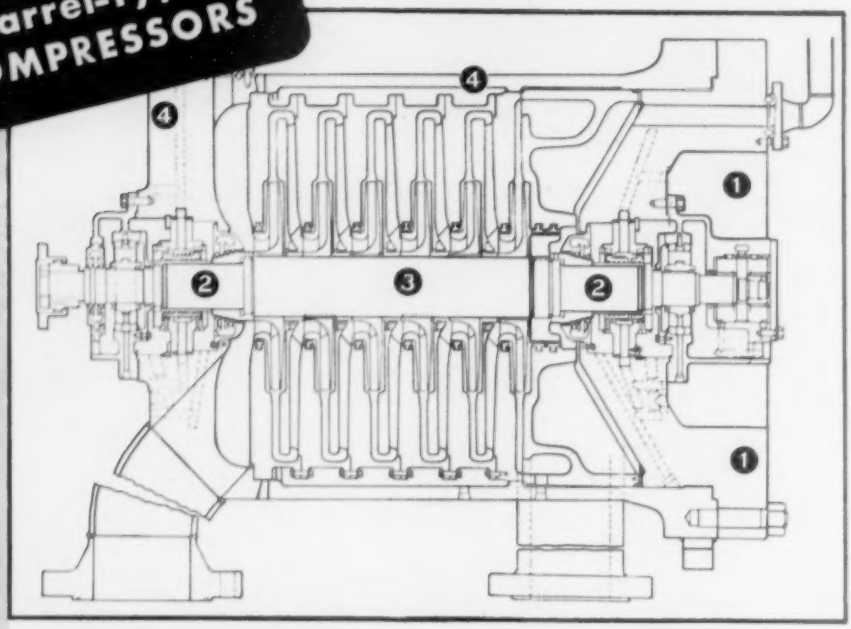
Bendix Computer

Bendix Computer Division, Bendix Aviation Corp.
5630 Arbor Vitae Street, Los Angeles 45, Calif.
Tell us how we can economically use the Bendix Computer in our engineering, research and control functions.

Name _____ Title _____

Company _____ Address _____

ALLIS-CHALMERS
High Pressure
Barrel-Type
COMPRESSORS



Features:

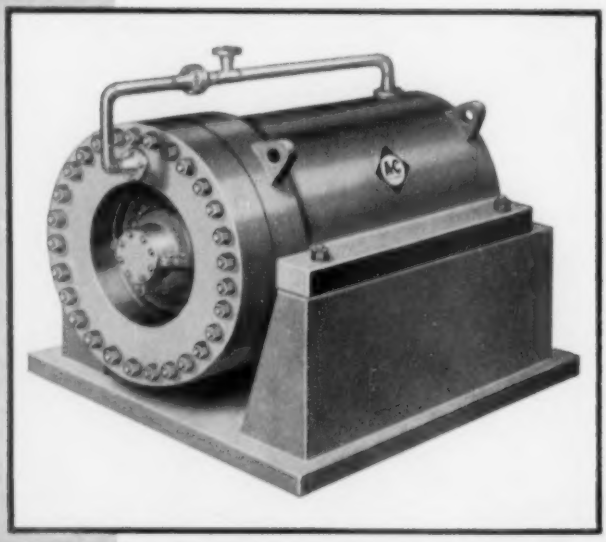
❶ Simple to Maintain — Only one head bolted on. Spiral-wound metallic head gasket can be installed without cement or grease—quickly removed and reused if needed.

❷ Shaft Sealing — Double bushing seals with separate high pressure seal oil system. Inward seal leakage minimized.

❸ Rugged Rotor—For years of high speed operation. Impellers shrunk and keyed to shaft. Rugged riveted impellers with rivets milled integrally from blade edge.

❹ Extra Strong — Vertically split forged steel casing — safe at high pressures.

Here's Unit Chosen for Reforming Process



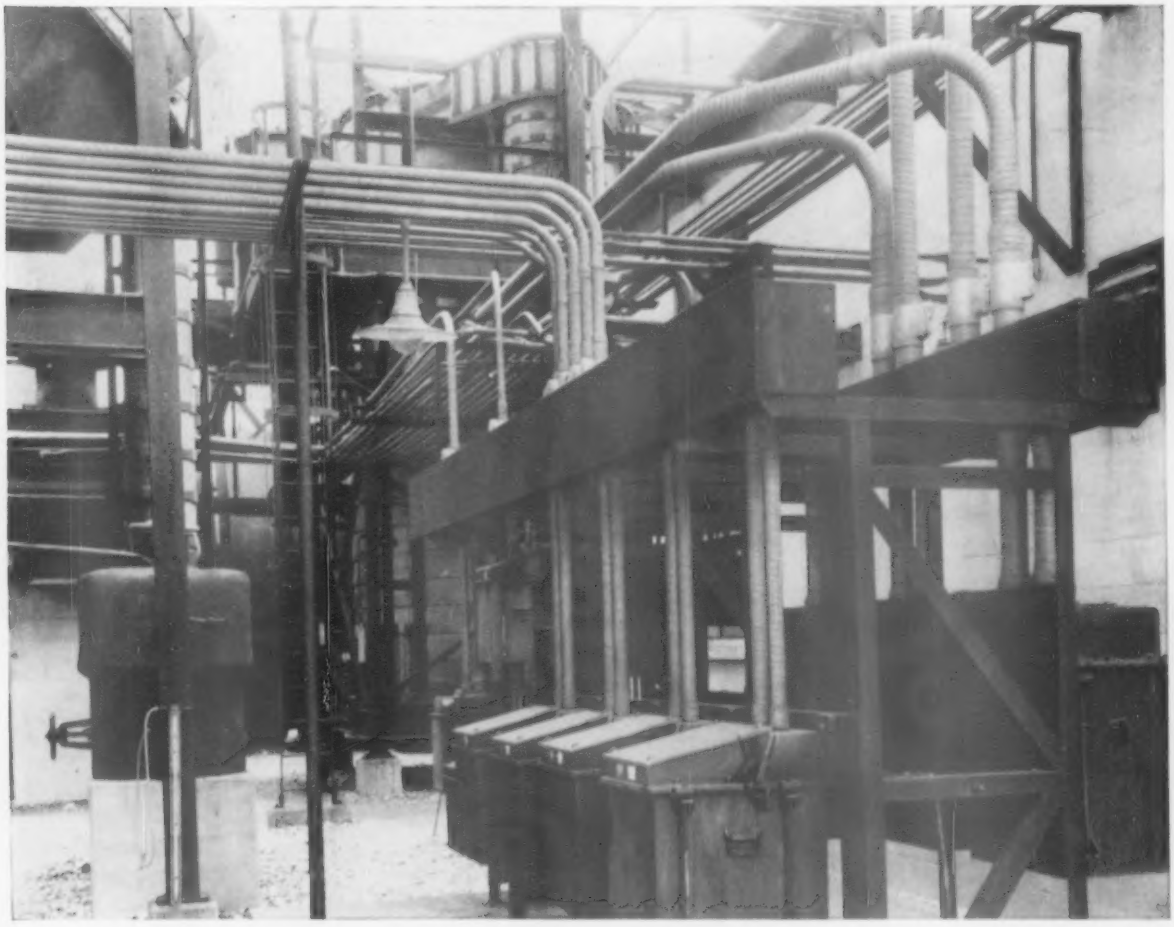
This compressor is typical of Allis-Chalmers high pressure barrel units for "upgrading" processes.

Above are a few of the features that make it easy for maintenance men to keep equipment on stream around the calendar. Details of this design are yours for the asking. Call your nearby A-C office or write Allis-Chalmers, Industrial Equipment Division, Milwaukee 1, Wis.

A-4967

A-C ALLIS-CHALMERS

ALLIS-CHALMERS



Polyken® protective coating beats corrosion in this sulphuric acid plant

They're using durable Polyken Tape *to protect electrical conduit in and around the cooling tower*

The Switch Box and Controller Station you see here is located at the cooling tower of Gulf Oil's Port Arthur, Texas, sulphuric acid plant. As you know, where there's sulphuric acid, there's a big need for protection against corrosion.

Formerly, they used paint on the electrical conduit. That lasted only three or four months.

But *Polyken* Protective Coating has kept the conduit in excellent condition since 1953. The tape itself is in excellent condition, too.

Polyken Tape gives dependable protection because it's manufactured from controlled raw materials under controlled conditions. Its tough polyethylene backing offers high electrical insulation resistance, high resistance to corrosive action.

Just as important, *Polyken* Protective Tape Coatings go on right from the roll. The thick adhesive mass provides strong adhesion to cylindrical surfaces and a self-seal at the lap. That means faster, more effective, lower-cost application—when it's put on and in the long run. Send the coupon or see catalog in Sweets Industrial File, Sec. 6c/Ke.

Polyken®

CONTROLLED STRENGTH

PROTECTIVE COATINGS

THE KENDALL CO., POLYKEN SALES DIVISION

Polyken, Dept. OG-C
222 West Adams St., Chicago 6, Illinois

Please send me samples and further information on *POLYKEN* PROTECTIVE TAPE COATINGS.

Name _____ Title _____

Company _____

Street Address _____

City _____ Zone _____ State _____

BP SETS NEW REFORMING RECORD WITH PLATFORMER

UOP UNIT CONVERTING MIDDLE EAST NAPHTHA INTO 92 PLUS F-1 CLEAR PRODUCT

A UOP Platforming unit at one of The British Petroleum Company's refineries has been producing consistently since early November, 1955, a 92 plus F-1 octane number blending component from Kuwait naphtha. This high octane number is on a butane-free Platformate without addition of tetraethyl lead.

This result is especially noteworthy since Kuwait and other Middle East stocks are of a highly paraffinic nature, recognized as among the most difficult naphthas to upgrade to virtually "super" F-1 clear octane levels.

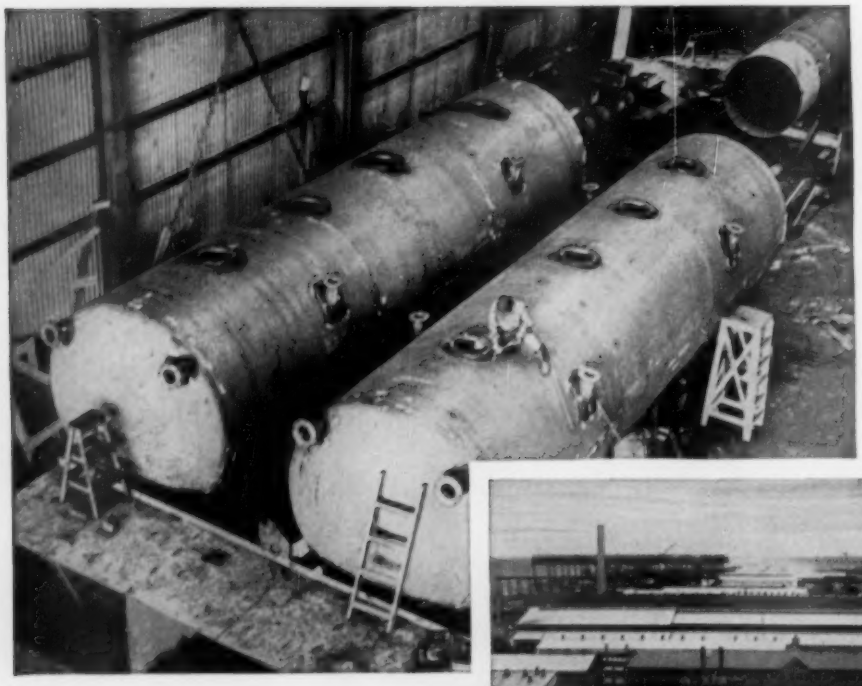
The standard R-5 UOP Platforming catalyst, produced in England by Universal-Matthey Products, Limited, is being used to achieve this unusual performance.

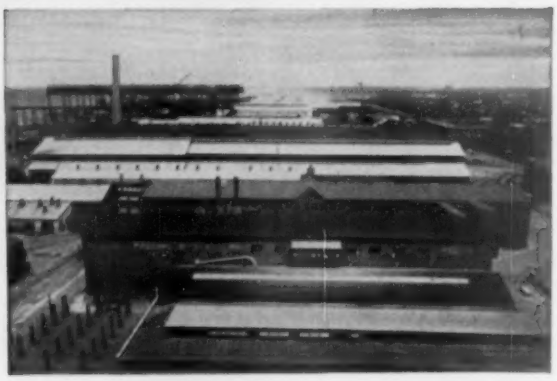
BP has UOP Platformers in operation at seven of its important plants throughout the world. Like BP, refiners everywhere can rely on the UOP Platforming process to solve their high octane problems.

UNIVERSAL OIL PRODUCTS COMPANY

30 ALGONQUIN ROAD, DES PLAINES, ILL., U.S.A.

Forty Years of Leadership In Petroleum Refining Technology





A Mile of Shops – Each shop is devoted to a special type of heavy production. Included are complete Machine Shops, casting, forging and other facilities which offer all of the advantages of the execution of the complete job.

A half mile of pressure vessels

These are two of seventy – over ½ mile – of 38½-foot vacuum tank casings built to meet the quality requirements of a well-known processor.

The buyer also benefits from many savings made possible by Newport News extensive heavy fabrication equipment and the sixty years experience in using it.

Do you plan installations of heavy production equipment? You can command the services of Newport News for weldments of corrosion-resistant, alloy and clad metals in almost any size or shape, plus the required engineering background and complete welding and stress-relieving skills.

It will pay you to get the facts, shown in *Facilities and Products*. As you glance at its photos and brief captions, you'll see why Newport News can turn out – at low cost – specialized heavy equipment for process plants.

Send for *Facilities and Products* – free – today.

Newport News
Shipbuilding and Dry Dock Company
Newport News, Virginia

PIPELINE news from L·O·F GLASS FIBERS COMPANY

Blue Flag Pipe Wrap being applied on the El Paso Natural Gas Company's 30" Permian-San Juan Cross-Over pipeline. Blue Flag was used in the rugged Zuni mountain terrain of western New Mexico for long-term, low-cost, effective protection.

El Paso Natural Gas helps protect huge pipeline investment with Blue Flag Pipe Wrap

Companies like El Paso Natural Gas, with huge pipeline investments, know they can rely on Blue Flag Pipe Wrap to give them maximum pipeline protection.

Blue Flag provides extra years of corrosion protection—for less than ½% of initial cost. It greatly increases enamel strength . . . offers exceptional resistance to cracking . . . helps protect the coating from backfill damage.

Blue Flag speeds over-the-ditch machine application. Its high tensile strength, provided by parallel glass-yarn reinforcements, practically eliminates breakage. Its uniform porosity permits the hot enamel to bleed through quickly—allows trapped gas to escape.

For long-term pipeline protection—swiftly and economically applied—use Blue Flag Reinforcing Pipe Wrap . . . available from strategically located distributor warehouses. For technical data, write: L·O·F Glass Fibers Company, Dept. 78-36, 1810 Madison Ave., Toledo 1, Ohio.

L·O·F GLASS FIBERS
BLUE FLAG PIPE WRAP

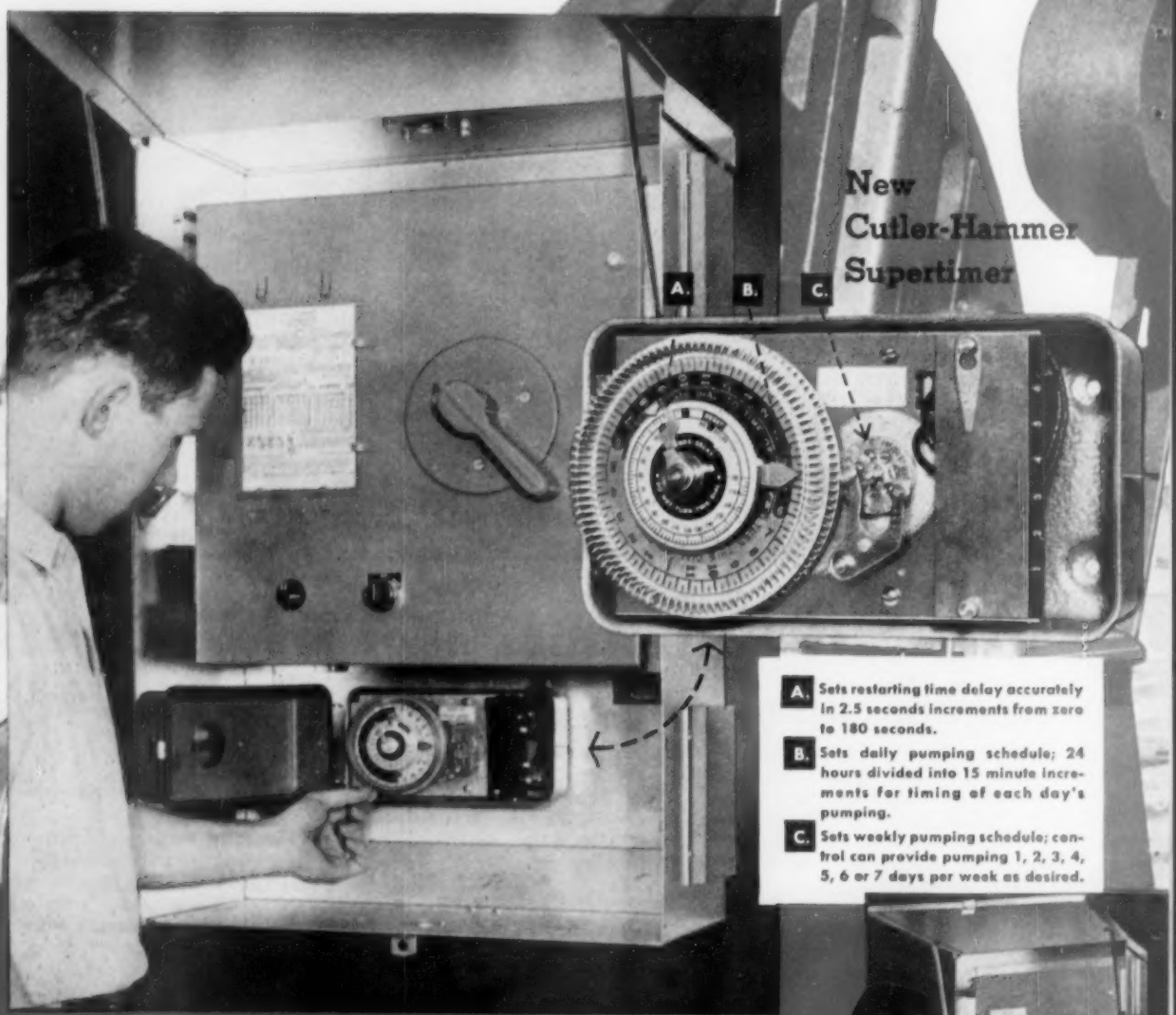
L·O·F GLASS FIBERS COMPANY

TOLEDO 1, OHIO

Makers of glass fibers by the exclusive "Electronic-Extrusion" process

A Complete Line For Pipeline Protection: BLUE FLAG Reinforcing Pipe Wrap • **DURAMAT** Protective Outer Wrap • **DURAMESH** Pipeline Fabric • **DURATAPE** Pipe and Joint Wrap

New Cutler-Hammer brings **full automation**



New Cutler-Hammer Supertimer

A. Sets restarting time delay accurately in 2.5 seconds increments from zero to 180 seconds.

B. Sets daily pumping schedule; 24 hours divided into 15 minute increments for timing of each day's pumping.

C. Sets weekly pumping schedule; control can provide pumping 1, 2, 3, 4, 5, 6 or 7 days per week as desired.

Nothing left to chance

The new Cutler-Hammer Supertimer not only controls the pumping schedule, it offers a selection of 73 restarting time delays in 2.5 seconds intervals from zero seconds to three minutes. This allows definitely timed sequence restarting of any number of pumps after any power interruption, avoids unfortunate coincidental restarts.

Three-Star Motor Control

to oil well pumping

If automation means completely automatic operation, oil well pumping has it today. With a remarkable new Cutler-Hammer Three-Star Motor Control unit, oil wells can now be pumped on a pre-set schedule to meet any field allowable . . . completely unattended *indefinitely* as far as the programming or the electrical equipment is concerned. When a power outage occurs, any number of pumps restart in a fixed sequence to prevent overloading the power lines. The control is protected against lightning and the motors are protected against single-phasing which often results from lightning. Designed for cool operation even in the most blistering heat . . . bugs, sand, rain, or ice cannot enter the enclosure.

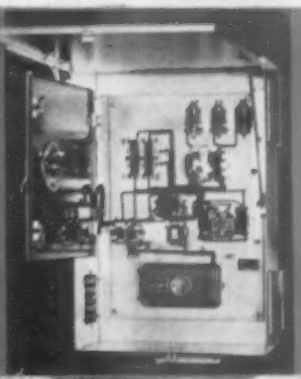
The heart of this new control is the Cutler-Hammer Supertimer. It does two things. First, it provides the means for setting the desired pumping schedule (hours per day and days per week). Second, it provides 73 accurately *controlled* restarting intervals (restarting time delays from zero seconds to as much as three minutes) to provide *definite* sequence starting of any number of pumps after any power interruption. Nothing is left to chance; unfortunate coincidental restarting of even two pumps is *impossible*. Other Plus Features include "dead-front" protection for pumpers, selector switch for normal automatic operation or manual control for testing and maintenance, new advanced-designed lightning arresters for positive control protection, full three-phase—three-coil overload protection for complete motor overload protection. This control has *everything*, particularly the engineered dependability so vital in any automation.

Your nearby Authorized Cutler-Hammer Distributor is stocked and ready to serve you. Order from him today. CUTLER-HAMMER, Inc., 1453 St. Paul Avenue, Milwaukee 1, Wisconsin. *Associate:* Canadian Cutler-Hammer, Ltd., Toronto, Ontario.

Member American CUTLER-HAMMER MOTOR CONTROL C-H *Petroleum Institute*

Nothing left to chance

This new control provides full "dead-front" protection for pumpers. The disconnect switch can be thrown, the overload relays can be reset, the Supertimer dials can be adjusted, and test operation by manual control can all be accomplished without exposure to any live parts . . . an exclusive Cutler-Hammer feature.

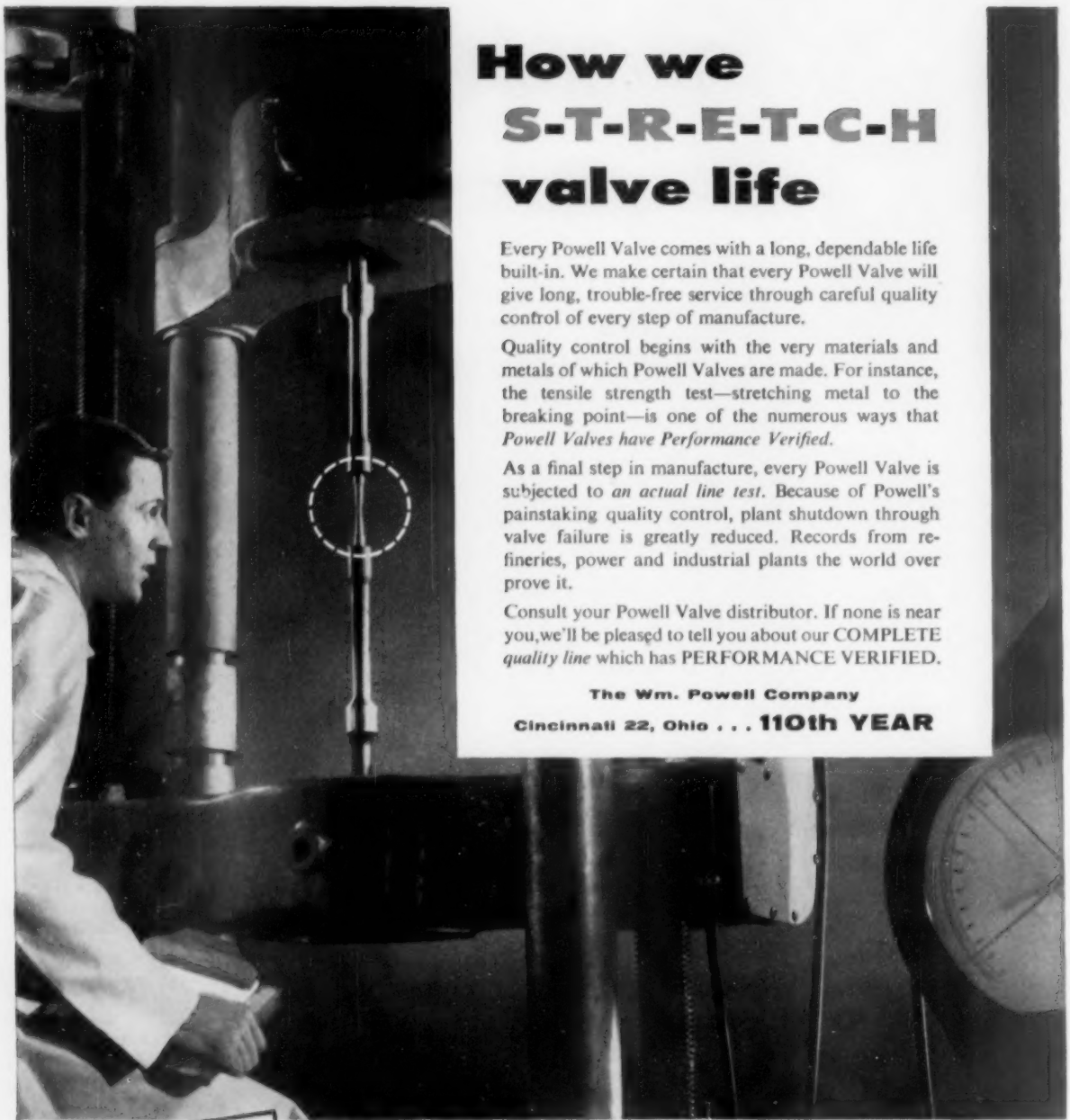


Nothing left to chance

This new control provides dead-phase protection. Protection from circuit unbalance, which can also produce destructive motor heating, is obtained by the use of *three* overload relays in this "nothing left to chance" control.

Nothing left to chance

Entirely new advanced-design power-line type lightning arresters in this new control not only provide more positive protection! they are arranged so it is impossible for anyone to inadvertently connect a lead for some special purpose in a manner which can destroy the protection afforded by the lightning arresters.



How we S-T-R-E-T-C-H valve life

Every Powell Valve comes with a long, dependable life built-in. We make certain that every Powell Valve will give long, trouble-free service through careful quality control of every step of manufacture.

Quality control begins with the very materials and metals of which Powell Valves are made. For instance, the tensile strength test—stretching metal to the breaking point—is one of the numerous ways that *Powell Valves have Performance Verified.*

As a final step in manufacture, every Powell Valve is subjected to *an actual line test.* Because of Powell's painstaking quality control, plant shutdown through valve failure is greatly reduced. Records from refineries, power and industrial plants the world over prove it.

Consult your Powell Valve distributor. If none is near you, we'll be pleased to tell you about our COMPLETE *quality line* which has PERFORMANCE VERIFIED.

The Wm. Powell Company

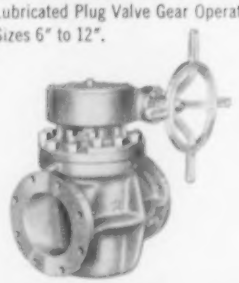
Cincinnati 22, Ohio . . . 110th YEAR

PERFORMANCE PV VERIFIED

FIG. 3003—Steel Gate Valve For 300 Pounds W.S.P.

FIG. 375—Bronze "White Star" Gate Valve For 200 Pounds W.S.P.

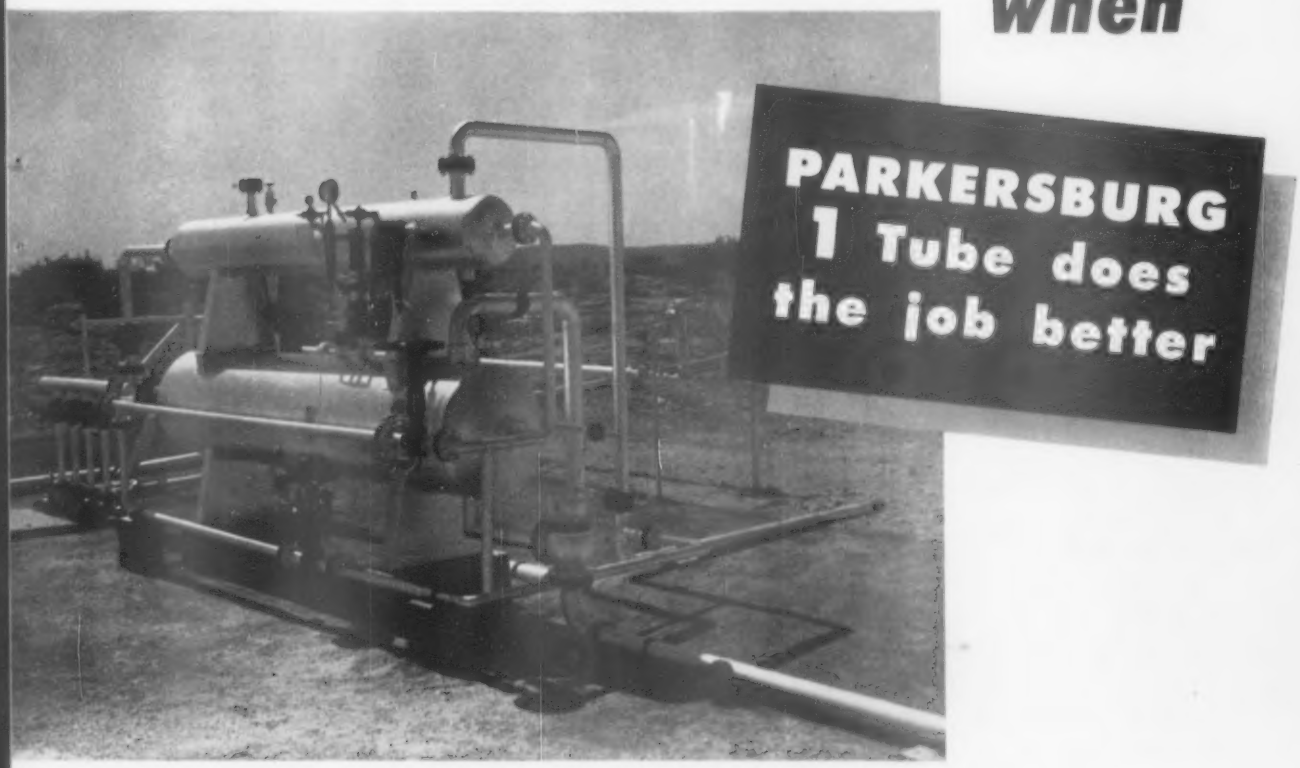
FIG. 3059G—300-Pound Steel Lubricated Plug Valve Gear Operated. Sizes 6" to 12".



POWELL VALVES

BRONZE, IRON, STEEL AND CORROSION RESISTANT VALVES.

why buy 2 tube separators when



Two-stage separation is a perfect example of the advantages offered by Parkersburg single tube horizontal separators.

How? A standard high pressure horizontal separator—without water legs, drip pots or second vessels—can be saddled on top of a standard low pressure horizontal separator to give you the most efficient two-stage unitized separator you can buy. And when needed, you can use either separator individually simply by breaking down the assembly.

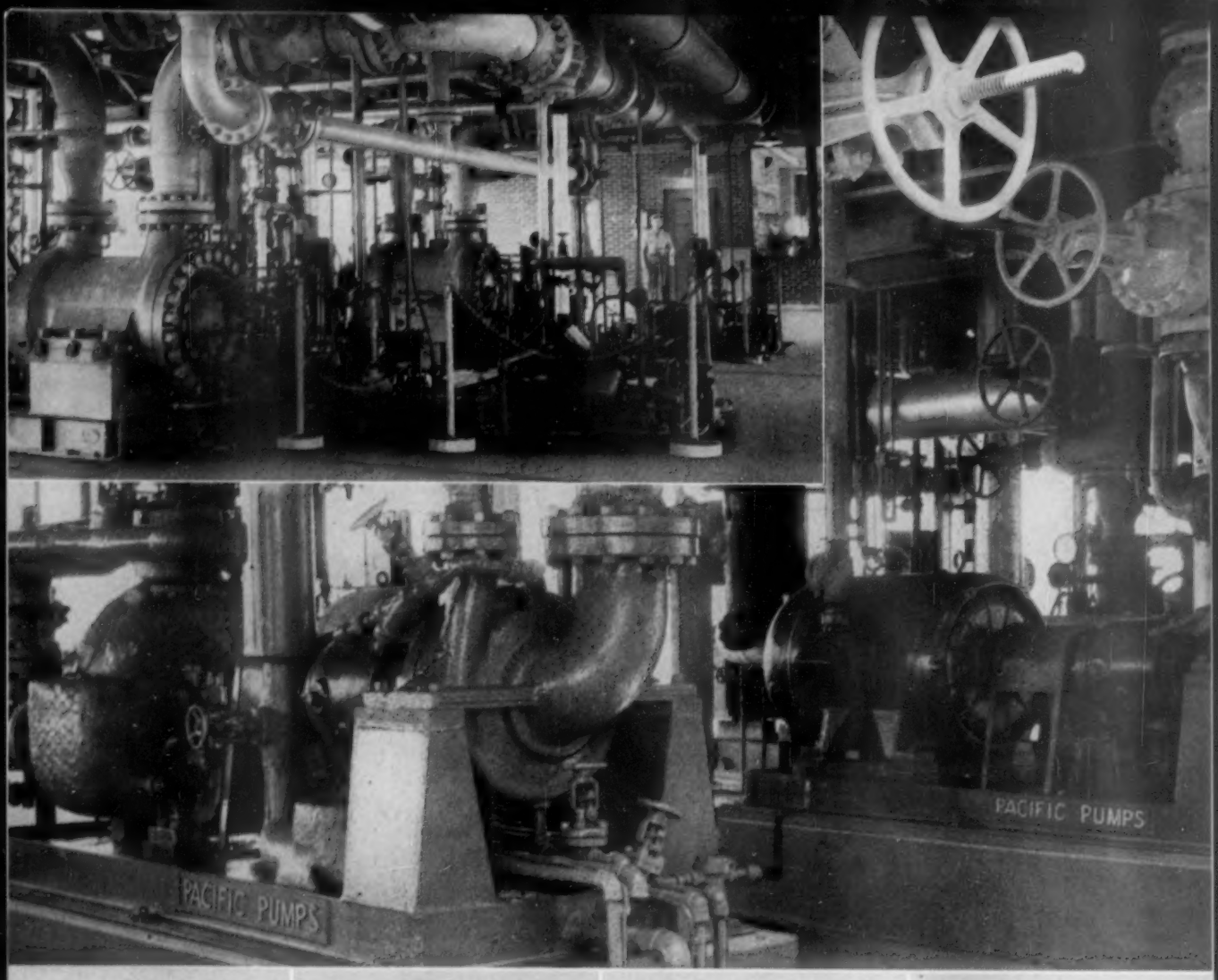
Easy to install, these units have all the outstanding performance features of Parkersburg's famous horizontal separators: 20% greater interface area for de-gassing; 20% slower gas flow for more effective natural separation; longer retention of more gaseous liquids; incoming fluid broken into largest possible droplets; all entrained liquid removed from gas stream; liquid level maintained by No-Bleed Level Controller.

● *Ask your Parkersburg representative how Parkersburg's Two-Stage Separators save you money by giving you dual service.*

Parkersburg
RIG AND REEL COMPANY
DIVISION OF PARKERSBURG : AETNA CORPORATION

3345 WINTHROP AVENUE
FORT WORTH 16, TEXAS

5608



IDECO

IDECO, Dallas, Tex.—Hydrair and Power Rigs; Full-View Masts; Substructures; Single, Dual and Drive-In Rambler Rigs; Blocks, Swivels, Rotaries; Mud Pumps; Petroleum Equipment and Supplies.

Magcobar.

MAGNET COVE BARIUM CORP., Houston, Tex.—Magcobar and Magcogel drilling muds and other specialized oil well drilling fluids and chemicals.

Security

SECURITY ENGINEERING DIVISION, Dallas, Tex., Whittier, Calif. — Rock bits, reamer rock bits and hole openers; reamers, casing scrapers and Neo-Red rubber stabilizers.

CLARK

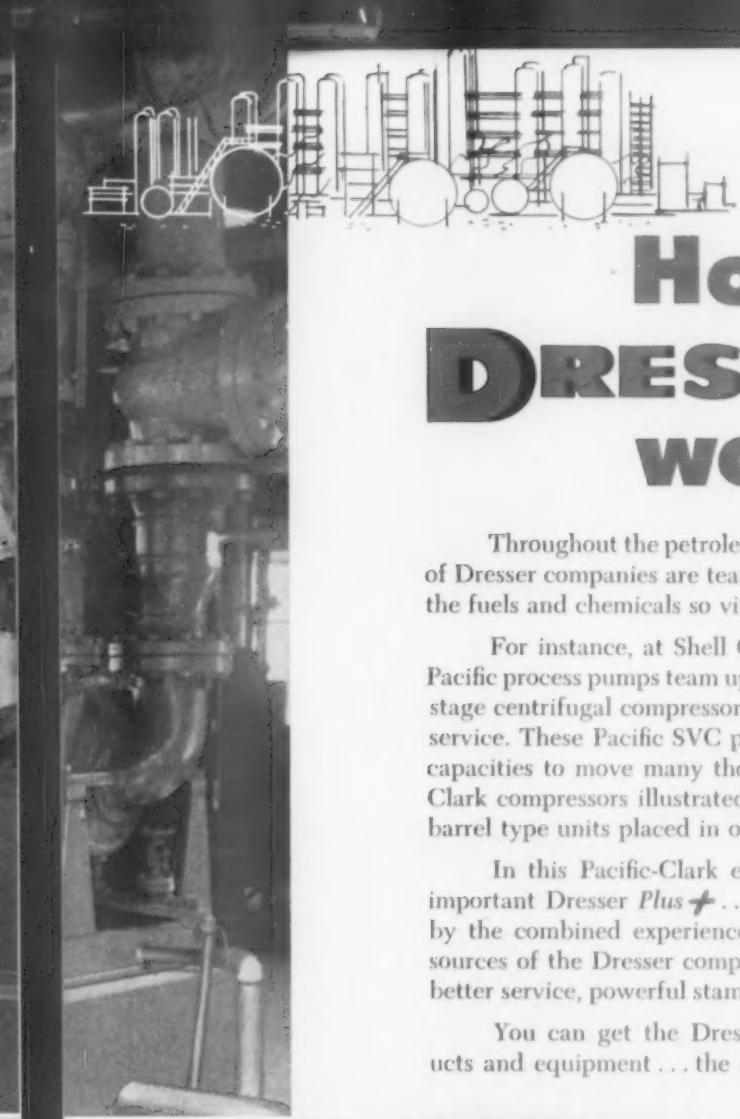
CLARK BROS. CO., Olean, New York—Gas turbines, engines, and reciprocating, centrifugal and axial flow compressors — gas, steam, electric and diesel driven.

ONE OF THE DRESSER INDUSTRIES

PACIFIC

the pump with the extra "oomph"

For more than thirty years, Pacific has supplied the refining, processing, and other industries with a range of pumps for every purpose. In the petroleum industry, Pacific pumps handle everything from the production of crudes to the finished, marketable product. For every industry, Pacific offers a rugged, durable pump for practically every purpose ... single-stage, multi-stage, horizontal and vertical types, with axial and radial split cases ... for all pressures and for extreme sub-zero temperatures and up to 850°F. Whatever your pumping requirements, you can rely on a Pacific pump to handle the work efficiently and economically.



How the DRESSER *plus* + works...

Throughout the petroleum and petrochemical industries, products of Dresser companies are teamed together to help produce and process the fuels and chemicals so vital to the modern world.

For instance, at Shell Oil Company's Deer Park, Texas refinery, Pacific process pumps team up with Clark heavy duty, barrel type multi-stage centrifugal compressors handling recycle hydrogen on reforming service. These Pacific SVC pumps shown in the large illustration have capacities to move many thousands of gallons of liquid per day. The Clark compressors illustrated at upper left are the first of these Clark barrel type units placed in operation.

In this Pacific-Clark equipment team the operators obtain the important Dresser *Plus* + . . . the dependability of equipment insured by the combined experience, research, engineering facilities and resources of the Dresser companies. This is realized in greater strength, better service, powerful stamina, and longer life.

You can get the Dresser *Plus* + by specifying Dresser products and equipment . . . the standard of comparison the world over.

ROOTS-CONNERSVILLE BLOWER DIVISION, Connersville, Ind.—Rotary positive blowers, gas pumps, centrifugal blowers, exhausters, and positive displacement meters.

LANE-WELLS CO., Los Angeles, Calif., Houston, Tex., Oklahoma City, Okla.—Electric and Radioactivity Well Logging, Koneshot perforating and bullet perforating, packers and bridging plugs.

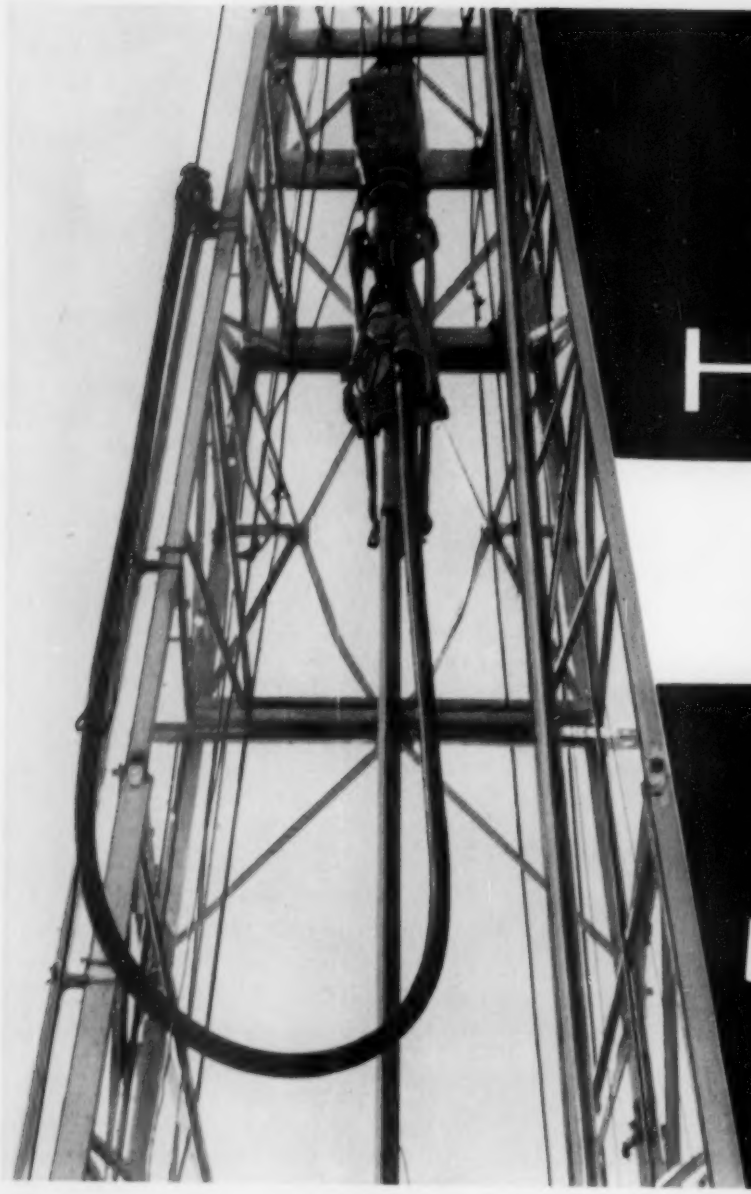
DRESSER-IDECO DIVISION, Columbus, Ohio—Radio and television broadcasting towers, steel buildings, aircraft hangars, mechanical parking garages, electric power substations.

DRESSER MANUFACTURING DIVISION, Bradford, Pa.—Pipe line couplings, pipe repair sleeves and clamps, weldments, forgings, welding fittings, flanges, rings.

DRESSER INDUSTRIES, INC.

OIL, GAS, CHEMICAL AND ELECTRONIC EQUIPMENT AND SERVICES

REPUBLIC NATIONAL BANK BUILDING • POST OFFICE BOX 718 • DALLAS 21, TEXAS



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Stocked in the Mid-Continent Area by JONES & LAUGHLIN SUPPLY DIVISION P.O. Drawer 2481, Tulsa 2, Okla. and the J & L Store in YOUR field.

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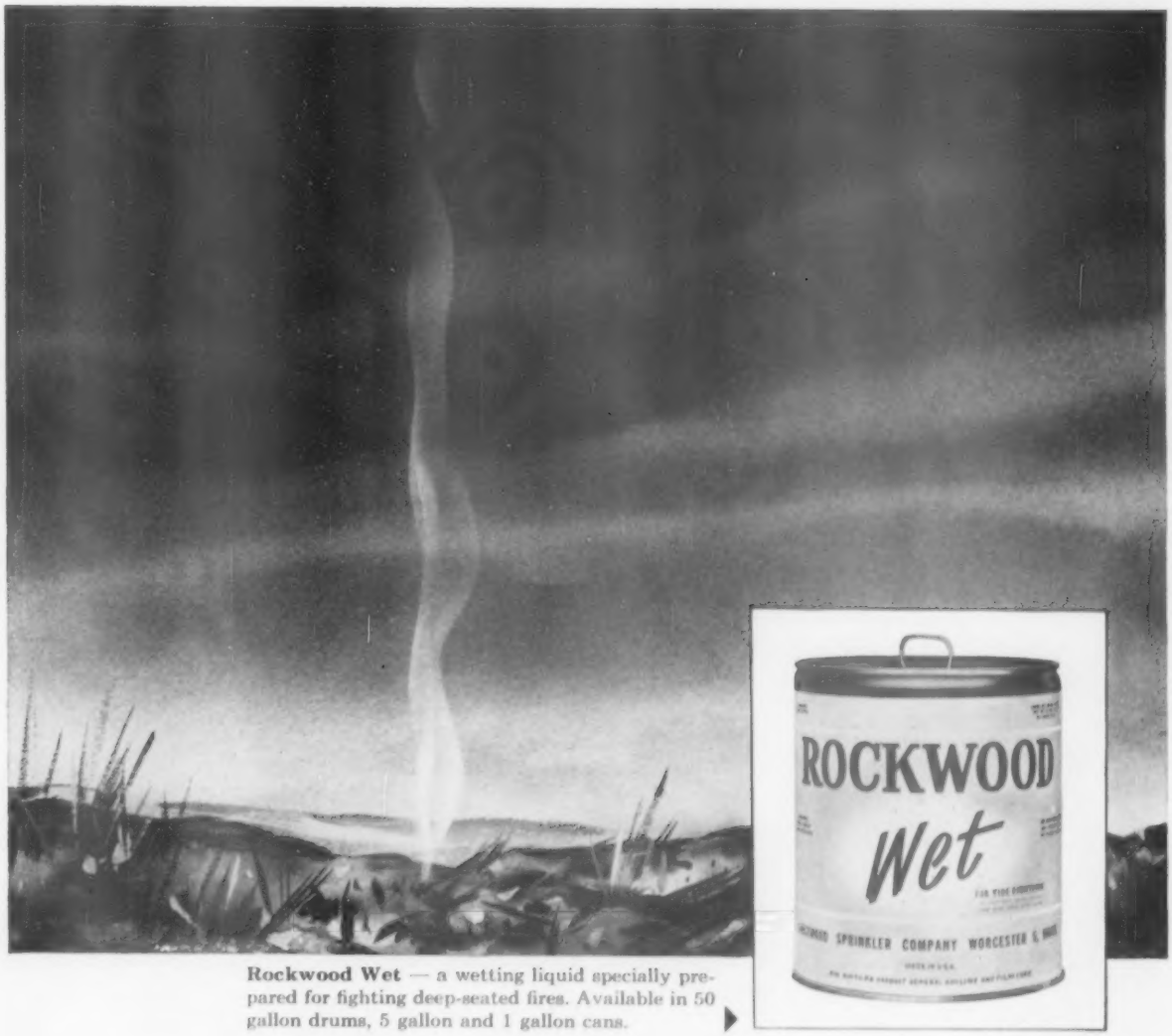
Stocked on the West Coast by HENDRIE BELTING & RUBBER CO. 405 Towne Ave., Los Angeles, Calif. PACIFIC COAST RUBBER COMPANY 51 Main St., San Francisco, Calif.



Rockwood Wet — a wetting liquid specially prepared for fighting deep-seated fires. Available in 50 gallon drums, 5 gallon and 1 gallon cans.

A fire fighter knows better

Water alone won't do it! The most effective way to fight this type of fire is to add Rockwood WET to the water.

It's the most effective way, because Rockwood WET increases the fire extinguishing action of water. The result is quick extinguishing, reduced rekindling — in less time . . . with less water!

The remarkable penetrating power of Rockwood WET reaches the very seat of the fire. And Rockwood WET retains its great depth of penetration even at fire temperatures. Tested and listed by Underwriters' Laboratories, Inc., Rockwood WET has proven its effectiveness against deep-seated fires in wood, paper, sawdust, cloth, rubber, etc.

You can use Rockwood WET in proportion of 1% for Class A fires and 2% for Class B fires. The Rockwood eductor and proportioner is specially designed for this purpose. It *automatically* proportions liquids at any fixed percentage, from 1% through 6%.

Put this fire fighter to work for you! For complete details write today for Rockwood's free illustrated catalog. Distributors in all principal cities.

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Engineers Water . . . to Cut Fire Losses

ROCKWOOD

ROCKWOOD SPRINKLER COMPANY
Portable Fire Protection Division
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Please send me your illustrated booklet on Rockwood WET.

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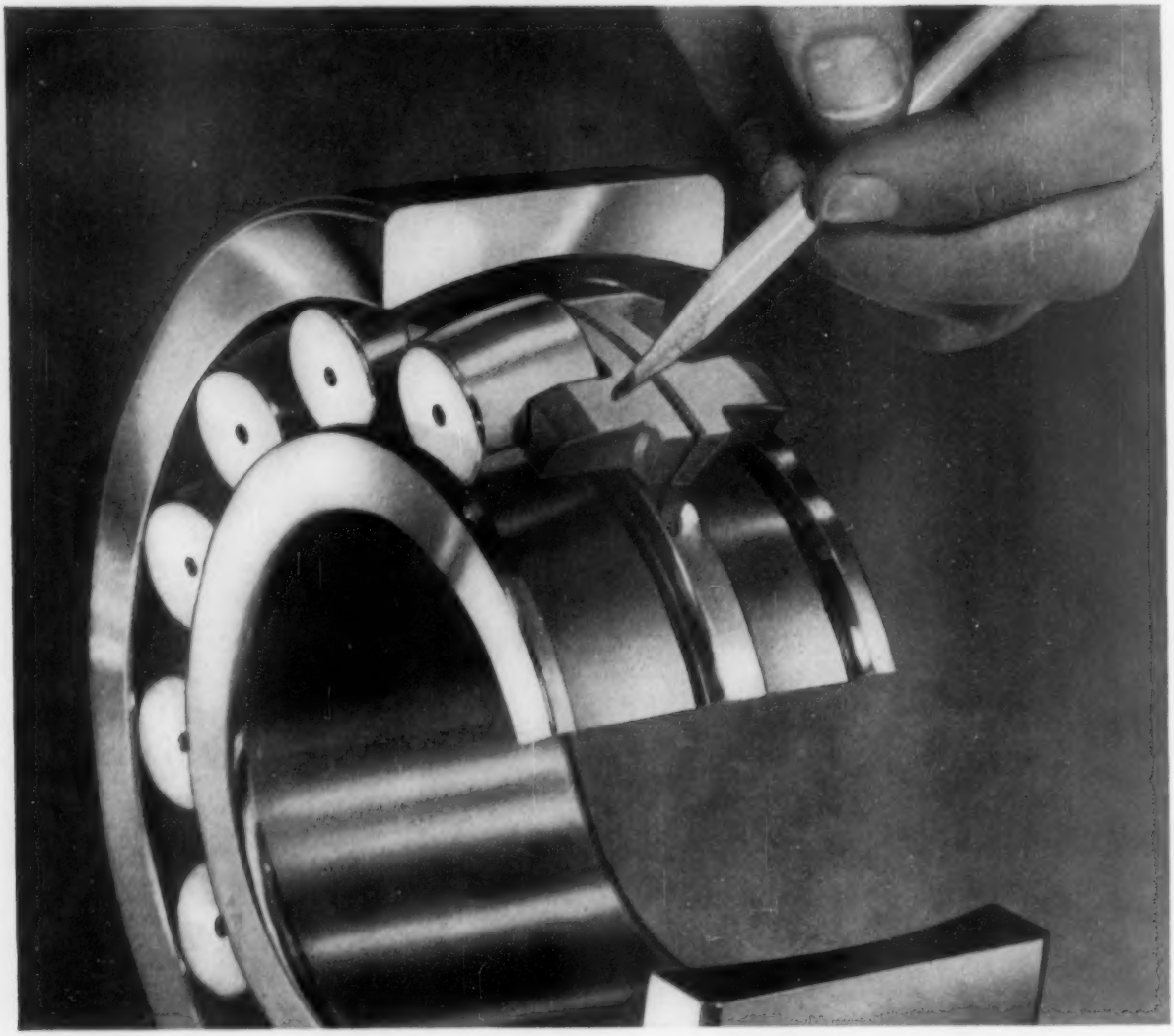
City..... *Zone*.... *State*.....

TORRINGTON *SPHERICAL ROLLER* BEARINGS



Land-riding cages for longer life!

These fully machined cast-bronze, land-riding cages—one for each path of rollers—are important performance builders in TORRINGTON'S Spherical Roller Bearings. The one-piece retainers keep the rollers perfectly aligned at all times, even under conditions of shock load and sustained speeds. Lubrication is more effective, too, as the lubricant has easy access to vital points of contact between rollers and races.

This feature is typical of TORRINGTON'S design, made possible through long experience in serving industry with the finest in precision bearings. That's why it pays to look to TORRINGTON first when your application calls for Spherical Roller Bearings. They're available from stock with either straight or tapered bore, for shaft or adapter mounting.

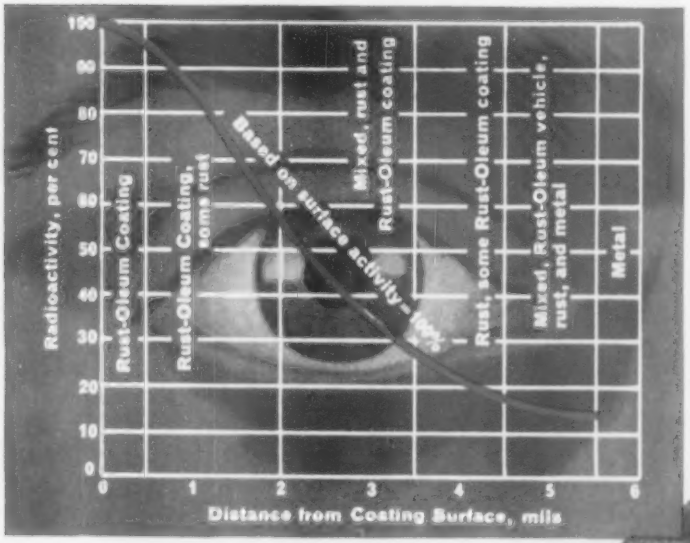
THE TORRINGTON COMPANY
South Bend 21, Ind. • Torrington, Conn.
District offices and distributors in principal cities of United States and Canada

90th ANNIVERSARY

TORRINGTON BEARINGS

Spherical Roller • Tapered Roller • Cylindrical Roller
Needle • Ball • Needle Rollers

See Rust-Oleum *penetrate rust* to bare metal through the "Eyes" of Radioactivity!



Curved line illustrates Rust-Oleum penetration through rust at each mil level as recorded by Geiger Counter.

Rust-Oleum dries to a firm, decorative coating that resists salt water, sun, fumes, heat, humidity, and weathering.

Geiger Counter traces Rust-Oleum penetration to bare metal! In nearly three years of radioactive research, Rust-Oleum's *specially-processed* fish oil vehicle was radio-activated and formulated into Rust-Oleum 769 Damp-Proof Red Primer—then applied to rusted test panels. Rust-Oleum's specially-processed fish oil vehicle was then traced through the rust to bare metal by Geiger Counter.

This penetration means rust-stopping power, because the fish oil vehicle works its way into the tiny pits in the metal where it drives out air and moisture that cause rust. Important savings are yours, because Rust-Oleum can be applied directly over sound rusted surfaces—usually eliminating costly surface preparations. Attach coupon to your business letterhead for your copy of the thirty-page report entitled, "The Development of a Method To Determine The Degree of Penetration of a Rust-Oleum Fish-Oil-Based Coating Into Rust On Steel Specimens," prepared by Battelle Memorial Institute technologists. Prompt delivery of Rust-Oleum is assured from your nearby industrial distributor.

There is only one Rust-Oleum. It is distinctive as your own fingerprint.

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STOPS RUST!

Rust-Oleum is available in practically all colors, including aluminum and white. See our complete catalog in Sweets, or write for information.

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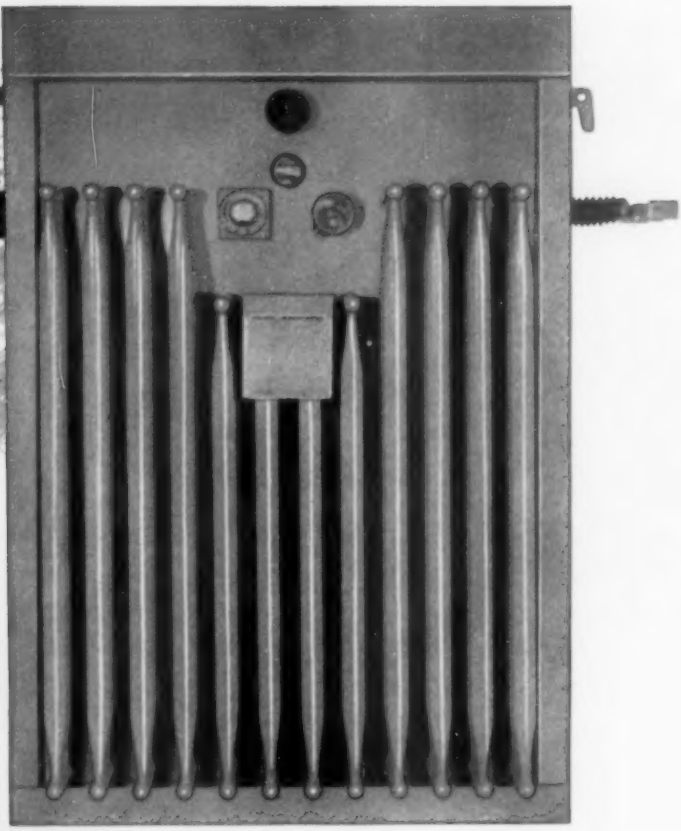
TRANSFORMERS
...the choice of leaders in industry



PLANNING A NEW LOAD CENTER?

...with the Wagner Close-Coupled Transformer, you can build a compact, modern unit substation

These Unit Substation Transformers save space... make a neat, streamlined installation

Wagner close-coupled, liquid-filled unit substation transformers can be easily flush-mounted with co-ordinated switchgear. And when they are, the result is a neat, modern, compact installation that not only saves space in your plant, but looks better too.

You get quicker delivery on a close-coupled Wagner transformer because there are fewer engineering difficulties than with the throat-connected type. It's not necessary to co-ordinate the bushing height of a close-coupled unit to match special switchgear. Bushing heights are designed to give ample room to make connection to switchgear or busses in the switchgear compartment or transition section. No need for special throats to match special switchgear.

Look to Wagner for transformers that assure a continuous dependable flow of power. Your nearby Wagner engineer will be glad to help you solve your load-center problems. Call the nearest of our 32 branch offices or write us.

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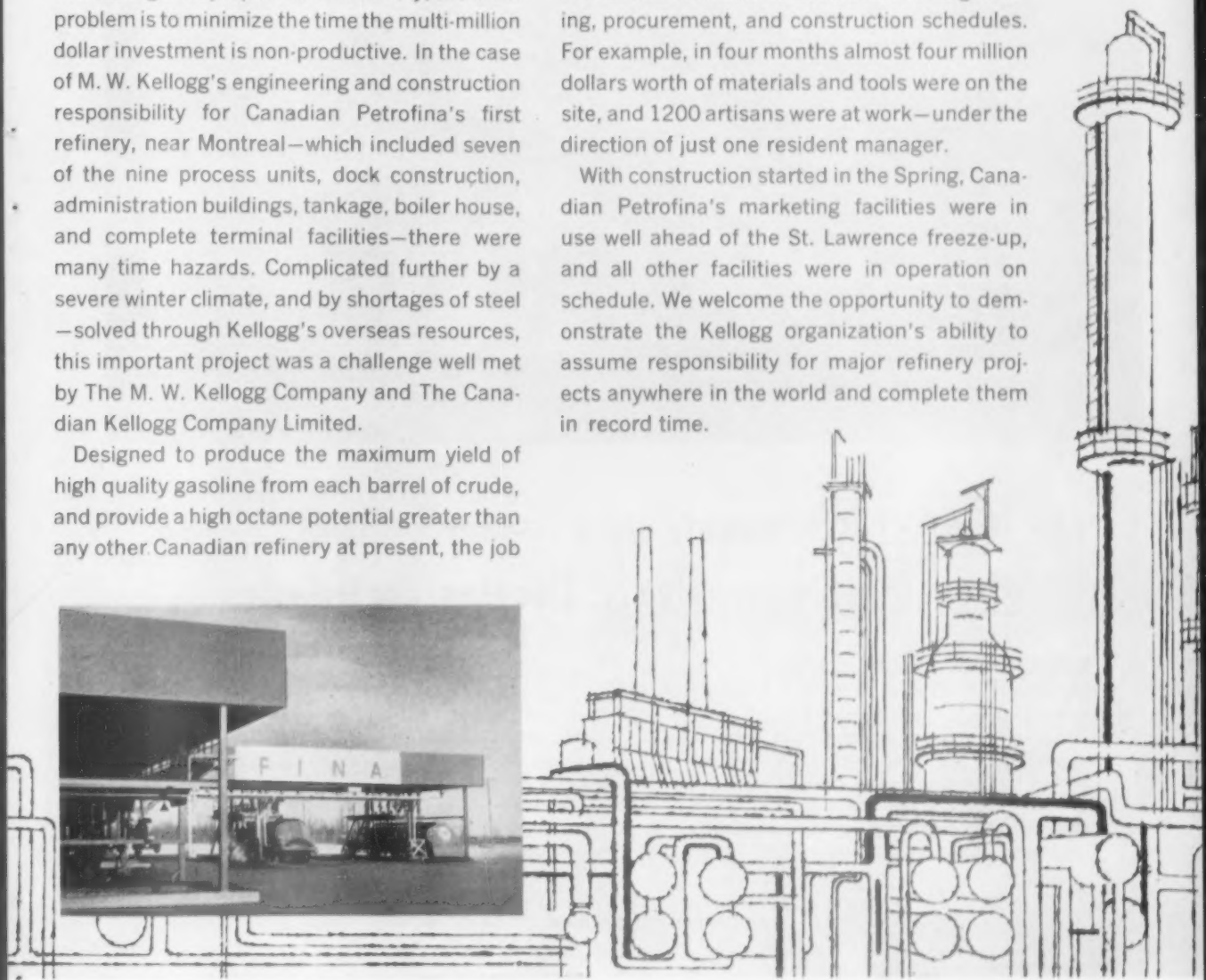
ELECTRIC MOTORS • TRANSFORMERS • INDUSTRIAL BRAKES • AUTOMOTIVE BRAKE SYSTEMS-AIR AND HYDRAULIC

Helping Another Oil Refiner Grow —with Fewest Growing Pains

In building a major petroleum refinery, the main problem is to minimize the time the multi-million dollar investment is non-productive. In the case of M. W. Kellogg's engineering and construction responsibility for Canadian Petrofina's first refinery, near Montreal—which included seven of the nine process units, dock construction, administration buildings, tankage, boiler house, and complete terminal facilities—there were many time hazards. Complicated further by a severe winter climate, and by shortages of steel —solved through Kellogg's overseas resources, this important project was a challenge well met by The M. W. Kellogg Company and The Canadian Kellogg Company Limited.

Designed to produce the maximum yield of high quality gasoline from each barrel of crude, and provide a high octane potential greater than any other Canadian refinery at present, the job called for maximum coordination of engineering, procurement, and construction schedules. For example, in four months almost four million dollars worth of materials and tools were on the site, and 1200 artisans were at work—under the direction of just one resident manager.

With construction started in the Spring, Canadian Petrofina's marketing facilities were in use well ahead of the St. Lawrence freeze-up, and all other facilities were in operation on schedule. We welcome the opportunity to demonstrate the Kellogg organization's ability to assume responsibility for major refinery projects anywhere in the world and complete them in record time.



REFINERY PROCESS DIVISION

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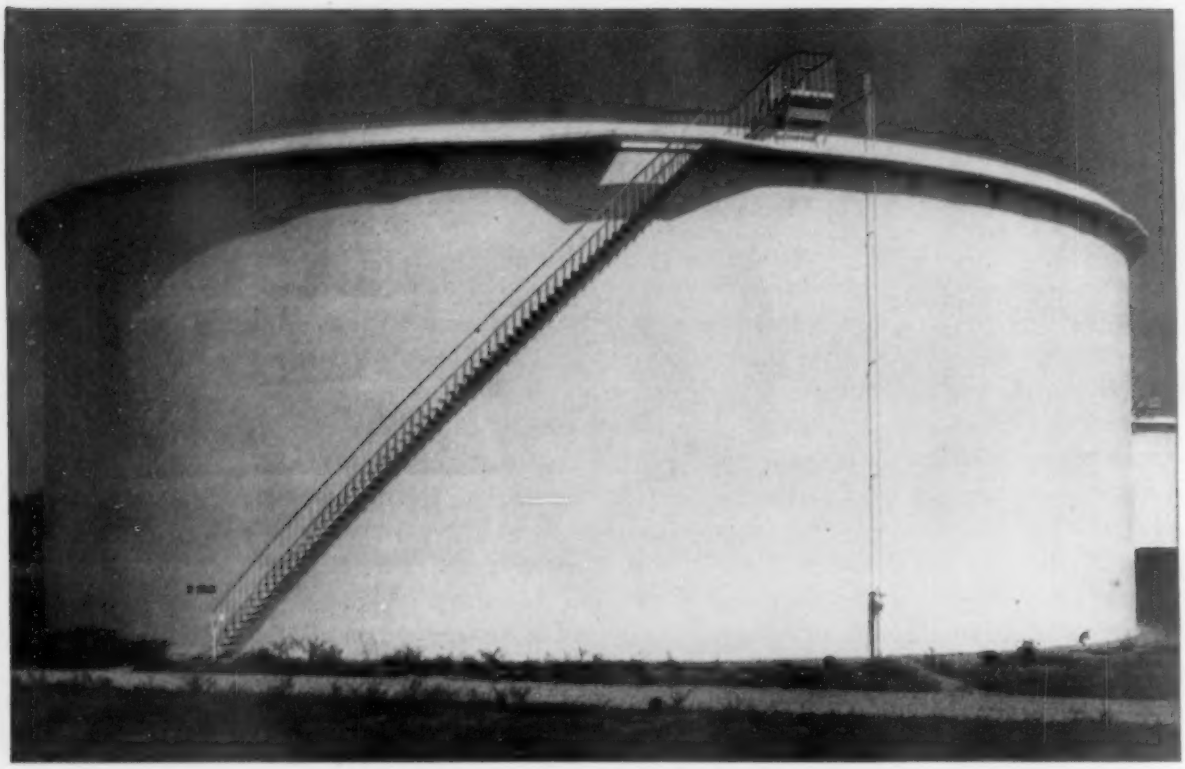

the GRAVER "Double-Deck"—our costliest... and often least expensive... floating roof design

While the Graver Double-Deck Floating Roof Tank is the costliest of our three "floaters," it often proves least expensive in the long run.

Its unusual strength and structural stability make it appropriate wherever storage problems are encountered. The double-deck roof, consisting of top and bottom deck plate, is divided into liquid-tight compartments. Thus it is practically unsinkable. With the Graver Double-Deck Floating Roof Tank maintenance costs are held to a minimum.

Other popular Graver designs include the Center-Weighted Floating Roof Tank which is unusually stable. We offer also a pan-type floating roof...an economical design suitable to southern climates where snow and ice present no hazard.

Whatever your storage needs it will pay you to contact Graver. Consultation costs you nothing, and competent Conservation Engineers are ready to serve you.

GRAVER ... *a conservation design to fit every need*

GRAVER FLOATING ROOF TANKS, four of which were built for the TEXAS PIPE LINE COMPANY at Port Arthur, Texas.

GRAVER TANK & MFG. CO., INC.

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TAP
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SYSTEMS

Hot taps into oil, steam, gas or water lines can be made without draining the system or even reducing pressure. The power operated Mueller DH-2 Drilling Machine makes the tap and activates the connection in complete safety, without loss of fluid.

A choice of No-Blo® fittings with an internal plug or valve have working pressures to 1200 p.s.i.—permit you to make practically any type connection you require.

Two types of power drive—air motor or gasoline engine drive unit—give the DH-2 Drilling Machine plenty of speed to complete the tap in a minimum of time.

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DH-2 Drilling Machine
Drills ¼" through 2⅛"
Power or hand operated
1200 p.s.i. at 100° F.
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Now...a New advance in...

Gauge Safety!

Another step ahead in Marsh Gauges: the new Marsh "Safecase". Down to the final detail this gauge is developed for those applications where an unexpected surge of heavy, explosive over-pressure can occur.

In the "Safecase" a solid metal barrier protects the entire face. But, still more important, the *entire back* of the gauge is a thin, ductile plate, designed to open out when subjected to abnormal pressure. Back plate is held firmly to the case by two holding screws and cannot be dislodged by a pressure blowout.

In exhaustive tests it has never been possible to shatter the crystal or create any other dangerous condition in a "Safecase" gauge with its safety-release back. The accompanying illustration shows the result of one of a series of tests in which blank cartridges were fired in the back of the case without even breaking the crystal. Think what that means in safety to operating men!

Yes, an important development . . . but merely the kind you would expect from the manufacturer who originated the "Connoweld" tube, the "Marshalloy" case, the Mastergauge movement and practically all of the major advancements in pressure gauges. Ask for up-to-the-minute information.

Pressure of explosive force merely opens out safety back

Instead of depending on blow-out plugs, entire back of Safecase Gauge is designed to yield to over-pressure. Photo at left shows actual result of firing cartridge within back of case. Safety-release back exhausted pressure. Front remained intact.

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Sales affiliate of Jas. P. Marsh Corp.
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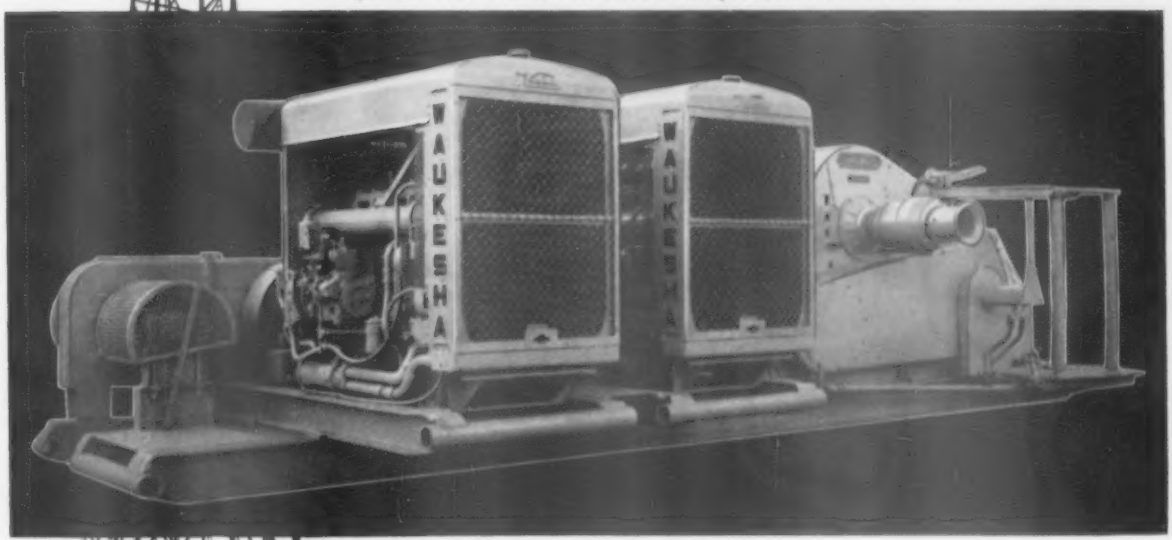
"THE STANDARD OF ACCURACY"

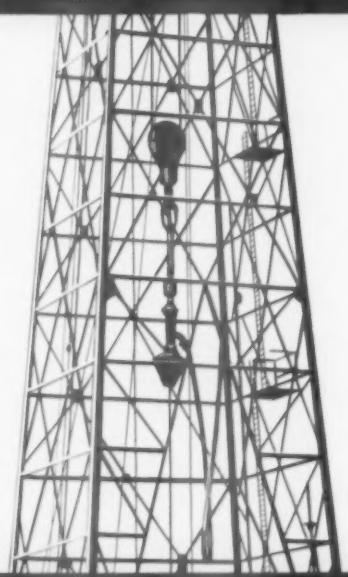
MARSH GAUGES

Twin WAUKESHA Units

power new CARDWELL draw works

Twin Waukesha WAKBU 1197 cubic inch Oil Field Special Gas Units power New Cardwell J-450 torque converter driven draw works





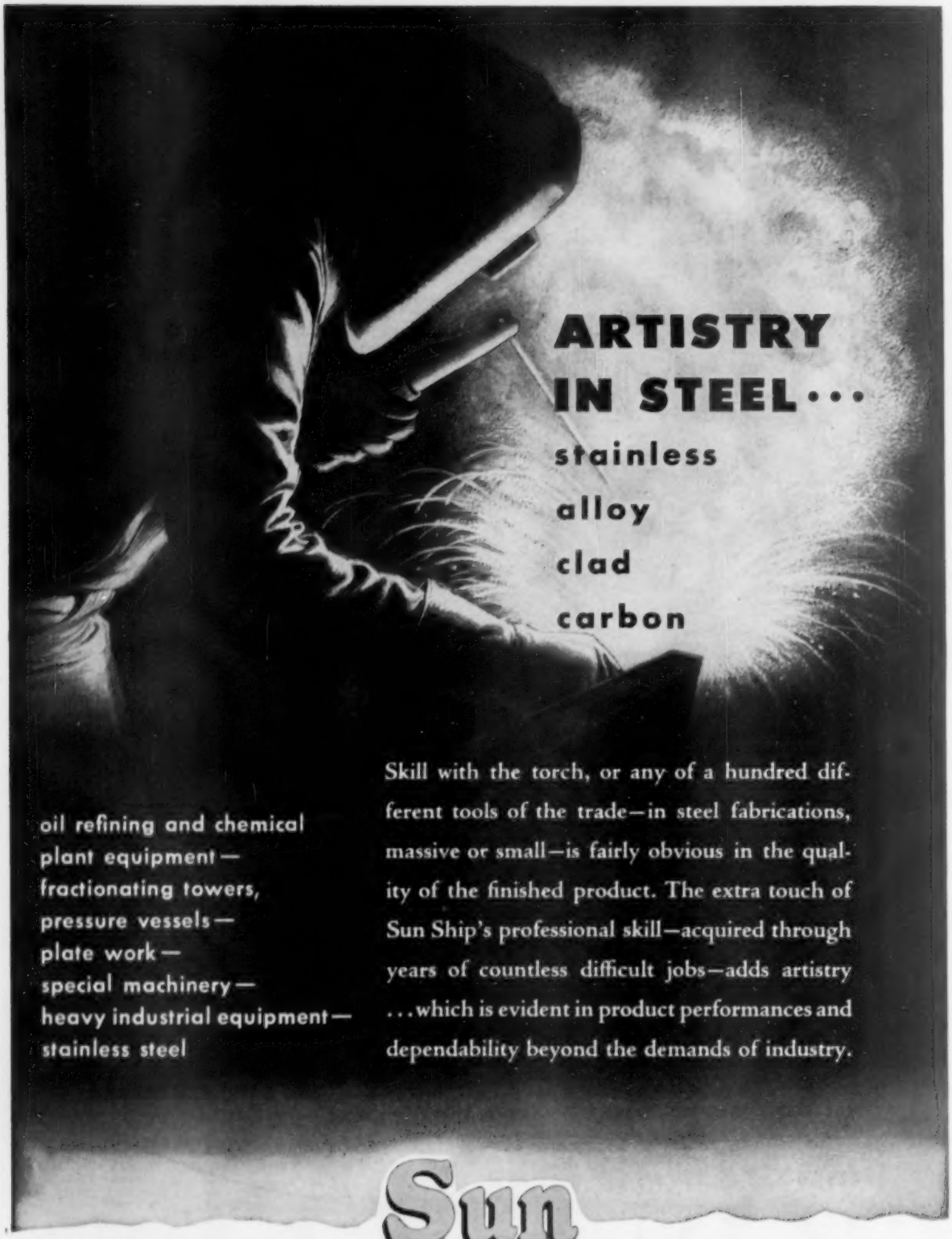
● With a normal workover range of 10,000-12,000 ft., a drilling range (4¼" pipe) of 4,500-6,000 ft., and rating of 450 nominal horsepower, the new Cardwell J-450 has the latest and finest drill rig design features. The power units shown here are Waukesha WAKBU High Output Oil Field Specials—each developing 250 max. hp at 1800 rpm on natural gas. They insure steady power under continuous duty load, and a lot more in reserve for emergencies. Their rugged, compact, overhead valve 1197 cu. in. engines, 6-cyl., 6¼-in. x 6½-in., have straight gas carburetor, regulator, water-cooled exhaust, aluminum pistons, counterbalanced crankshaft and vibration dampener. This new rig is also available with Waukesha WAK Series counterbalanced full Diesels. Send for WAK bulletins . . . gas or Diesel. 298

World's Finest Oil Field Power

WAUKESHA

50th ANNIVERSARY Waukesha MOTOR CO. 1906-1956

WAUKESHA MOTOR COMPANY, WAUKESHA, WISCONSIN • NEW YORK • TULSA • LOS ANGELES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IN STEEL...
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alloy
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plant equipment—
fractionating towers,
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plate work—
special machinery—
heavy industrial equipment—
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Skill with the torch, or any of a hundred different tools of the trade—in steel fabrications, massive or small—is fairly obvious in the quality of the finished product. The extra touch of Sun Ship's professional skill—acquired through years of countless difficult jobs—adds artistry ...which is evident in product performances and dependability beyond the demands of industry.
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SHIPBUILDING & DRY DOCK COMPANY
SINCE 1916
ON THE DELAWARE • CHESTER, PA.
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Armco Surface Casing... Ready when you need it from these convenient stocking points

When drillers need casing they usually need it in a hurry. Thus, ready availability is one of the important reasons why Armco Surface Casing has received such wide acceptance. Armco Casing is distributed by National Tank Company from 25 stocking points conveniently located throughout the oil country. Chances are one of these stocking points is near you.

An adequate supply of casing is maintained at these stocking points in sizes to meet your immediate needs. In addition, they will promptly handle your order for direct mill shipment.

Armco Casing offers many other advantages to drillers. Long, 40-foot lengths mean fewer sections to handle, fewer joints to assemble. The Armco Slip-Joint and uniformly round cross-section allow quick stabbing and fast, easy alignment. Diameters range from 6 to 24 inches, wall thicknesses from $\frac{3}{16}$- to $\frac{1}{2}$-inch. Write us for complete information. Armco Drainage & Metal Products, Inc., Welded Pipe Sales Division, 4366 Curtis Street, Middletown, Ohio, 201 KOME Building, Tulsa, Oklahoma. Subsidiary of Armco Steel Corporation. Export: The Armco International Corporation.

1. Swift Current, Canada
2. Williston, North Dakota
3. Casper, Wyoming
4. Sidney, Nebraska
5. Brush, Colorado
6. Great Bend, Kansas
7. Liberal, Kansas
8. Pawhuska, Oklahoma
9. Oklahoma City, Oklahoma
10. Seminole, Oklahoma
11. Hobbs, New Mexico
12. Pampa, Texas
13. Lubbock, Texas
14. Snyder, Texas
15. Abilene, Texas
16. Electra, Texas
17. Odessa, Texas
18. Corpus Christi, Texas
19. Houston, Texas
20. Shreveport, Louisiana
21. Lake Charles, Louisiana
22. New Iberia, Louisiana
23. Harvey, Louisiana
24. Clay City, Illinois
25. New Harmony, Indiana

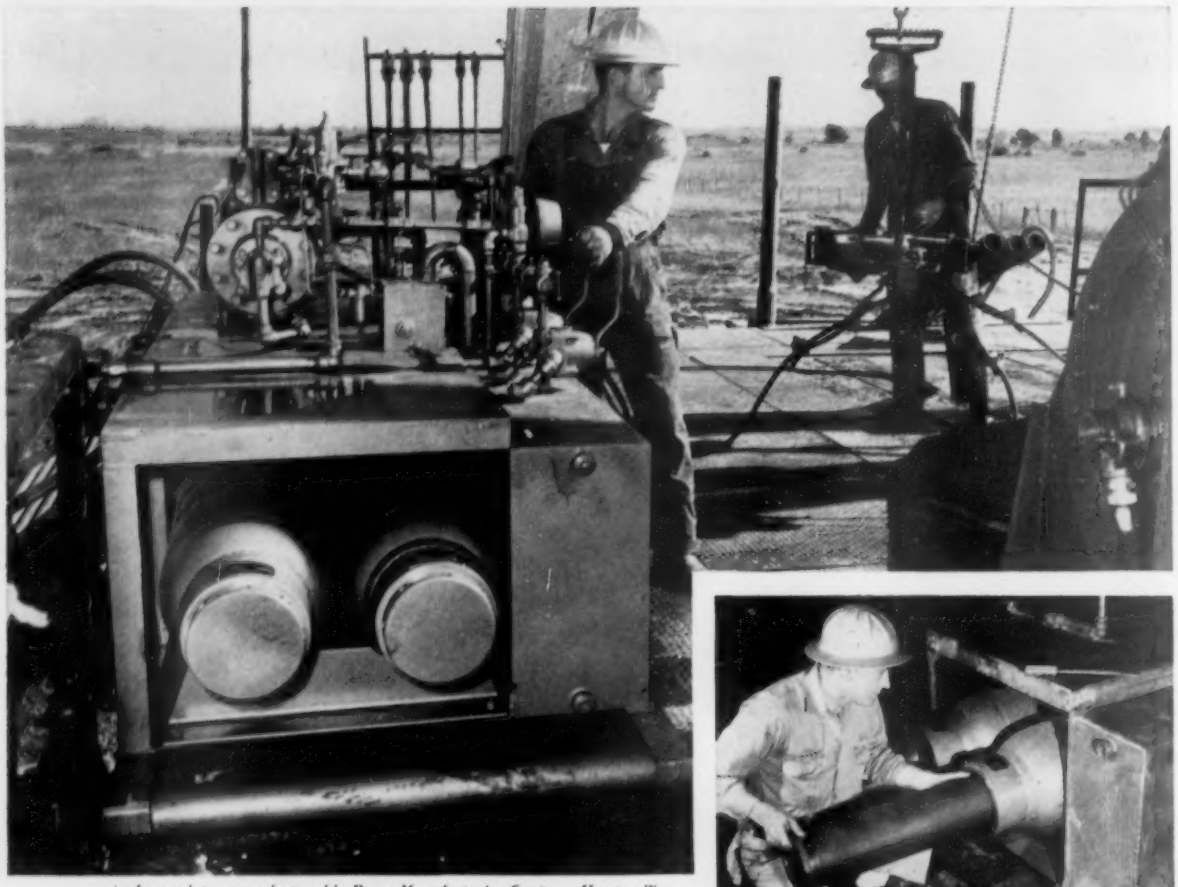
National Tank Company stocking points for Armco Casing

Armco Slip-Joint Casing

Distributed by National Tank Company, Tulsa, Oklahoma. In Canada: National Tank Company, Ltd.

Another new development using

B. F. Goodrich Chemical *raw materials*



Accumulators manufactured by Payne Manufacturing Company, Houston, Texas. Hycar bladders by F. H. Maloney Company, Houston, Texas.

Hycar stands by to stand off blowouts

CYLINDERS made from Hycar nitrile rubber act as pistons inside the pressure accumulator of this blowout preventer. Hycar has to take unusual punishment to keep the blowout preventer on the job—ready, in case of rig power failure, to deliver a 2,000 psi punch to close off high pressure gas blowouts.

First, the Hycar bladders are pumped full of nitrogen to 1,000 psi. Then hydraulic fluid is pumped into the steel cylinders around the Hycar bladders until the pressure is 2,000 psi. This pressure is then always ready to operate the blowout seal-off—fast!

This is one of the toughest tests of Hycar's performance. It must withstand very high pressures, yet have the elasticity to inflate like a balloon. It must have toughness and abrasion resistance to take the scraping it gets from metal parts when pressure is suddenly released. And it must resist the deteriorating effect of the hydraulic oil.

Many, many different characteristics can be built into products made from Hycar. The properties described here and many others often make Hycar the unique material that is the answer to design problems. For information on how Hycar can help with your particular requirement write Dept. EN-2 B. F. Goodrich Chemical Company, Rose Building, Cleveland 15, Ohio. Cable address: Goodchemco. In Canada: Kitchener, Ontario.

B. F. Goodrich Chemical Company
A Division of The B. F. Goodrich Company

Hycar
American Rubber

GEON polyvinyl materials • HYCAR American rubber and latex • GOOD-RITE chemicals and plasticizers • HARMON colors

we never underestimate the creative in construction . . .

Building petroleum refineries, petrochemical and chemical plants requires complete understanding of practical construction techniques. You know, and we know, that there is no substitute for experience, a thorough knowledge of tried-and-proved methods, in this business. But, there is an important something beyond this, too.

It is the "creative sense" ever present at Procon, the constant seeking for better, more practical, more economical ways to build the most efficient installations for our clients. We are ready to apply this creativeness to your construction problems.

PROCON *Incorporated*
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PROCON (*Canada*) LIMITED
TORONTO 18, ONTARIO, CANADA

PROCON (*Great Britain*) LIMITED
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WORLD-WIDE CONSTRUCTION FOR THE PETROLEUM, PETROCHEMICAL, AND CHEMICAL INDUSTRIES

CATFORMING

YOUR LOW-COST KEY TO HIGH OCTANES

CATALYSTS — Specific type for your problems.

SELECTIVITY — Superior yield at high octanes.

STABILITY — High activity with long life.

DURABILITY — Tolerance for moisture and nitrogen.

REGENERATION — To extend normal life or recover from upsets.

For further information on Catforming, write or wire The Atlantic Refining Company, P. O. Box 8138, Philadelphia 1, Pennsylvania.

it's the **CATALYST** that counts **ATLANTIC**

HIGHEST AWARD IN ENGINEERING

IT'S a repeat contract—and no medal or citation could indicate higher approval of McKee services.

In a half-century of engineering and construction McKee has been awarded over 2600 contracts by discerning businessmen who know what they want and where to get it. More than two-thirds of these were *repeat contracts.*

This willingness of large companies to repeatedly entrust to McKee the expenditure of millions of dollars in plant investment is proof of the value of McKee engineering and construction.

McKee
ENGINEERING &
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Protect your plant with the same Ansul extinguishers that guard this big steel mill

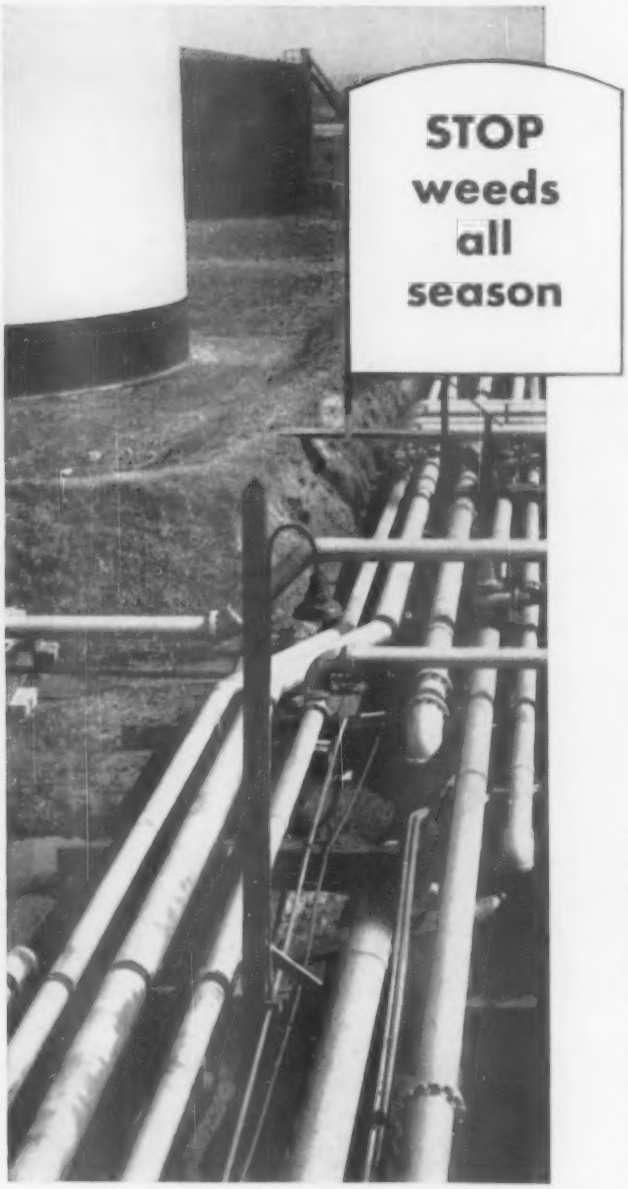
Well-planned safety and fire prevention programs are doing their share to protect lives, property and production schedules at the Great Lakes Corporation, Detroit, Mich., division of National Steel Corporation. Ansul fire extinguishers are playing a part in this successful program.

Your safety program deserves the best in fire protection. Remember, fire doesn't give you a second chance. Here are three big reasons why Ansul dry chemical extinguishers can take the worry out of your fire protection program and help you maintain a safety record to be proud of:

First. Ansul extinguishers are *dependable.* They are always ready for action, even under severe exposure conditions. Weather-tight construction assures this dependability. *Second.* Ansul extinguishers are *effective.* Patented nozzles deliver either a straight or fan stream, depending upon the hazard. This is an Ansul exclusive for more effective fire control. *Third.* Ansul extinguishers are backed by a *five-year warranty.* This is the best way we know of saying that Ansul extinguishers are the finest of their kind made anywhere. No other manufacturer offers this important warranty.

Get in touch with your local ANSUL MAN through the yellow pages of your phone directory, or write direct to ANSUL CHEMICAL COMPANY, DEPT. OG-3, MARINETTE, WISCONSIN.

ANSUL



Still weed-free one year after treatment with "Telvar." The area around the tanks and pipeline was sprayed with a single treatment of "Telvar" a year before this photo was taken. Weed-control costs are cut with "Telvar" because it gives thorough, long-term weed control.

FREE ILLUSTRATED BOOKLETS describe how to control weeds and brush with Du Pont chemicals. Write to Du Pont, Grasselli Chemicals Dept., Rm. D-4032, Wilmington, Del. In Canada, Du Pont Company of Canada Limited, 80 Richmond Street West, Toronto, Canada.

Spray just once with Du Pont TELVAR®

WEED KILLERS

When you use "Telvar" weed killers, vegetation is killed through the roots and regrowth is prevented because the chemical remains in the soil . . . provides residual action all season long. And low dosages (1 to 1½ lbs. per 1,000 sq. ft.) make it cost little for the results you obtain. Such low rates also mean less handling, less use of storage facilities.

"Telvar" weed killers come as wettable powders, are non-corrosive, non-flammable, non-volatile, low in toxicity to humans and livestock.

Include "Telvar" weed killers in your weed-control program this year. Prove to yourself how these products of Du Pont research can help cut your maintenance cost to new low levels.

• • •

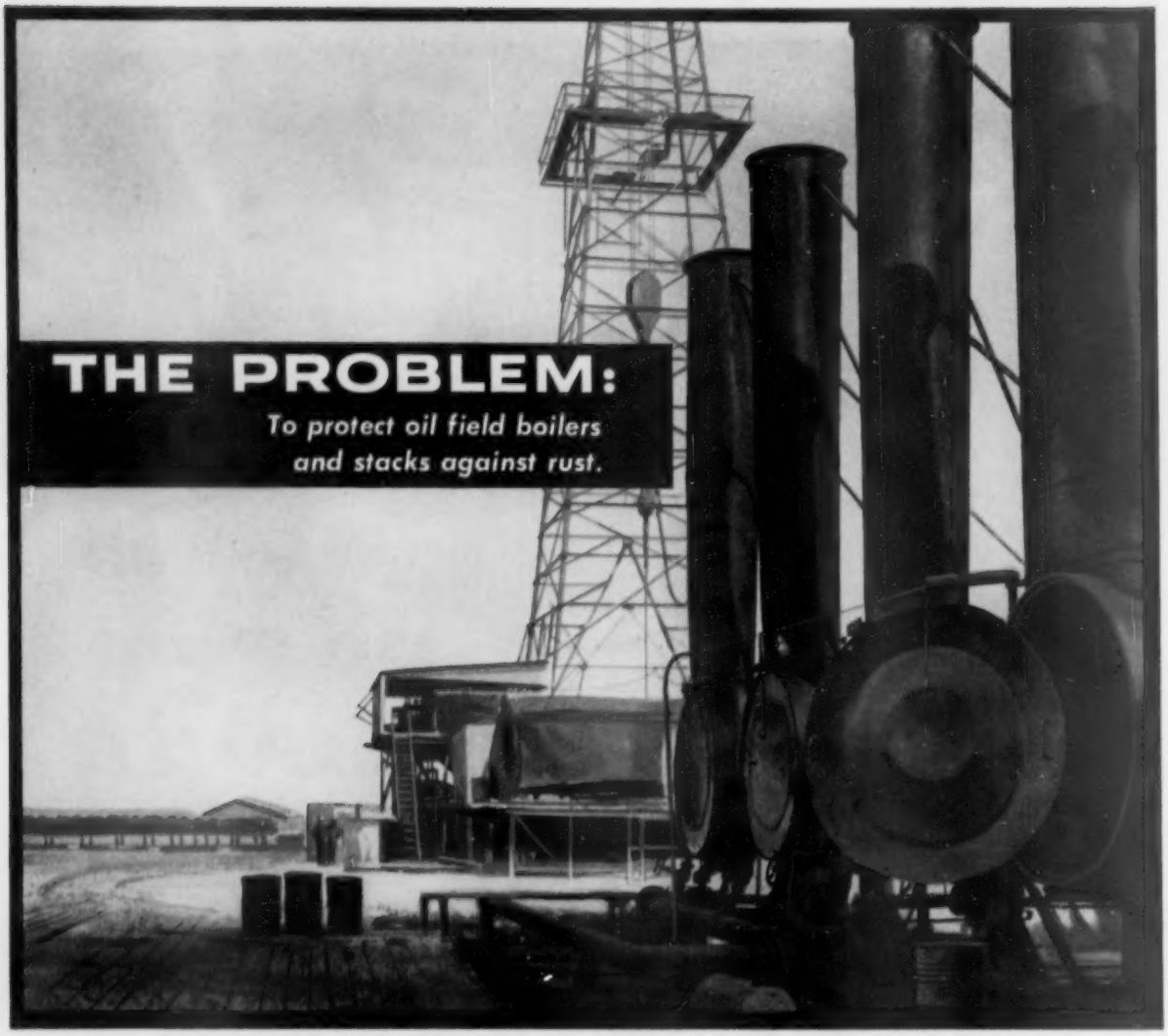
Where brush is a problem, Du Pont Ammate® X weed and brush killer is the product you need. It kills more kinds of brush with unusual safety. With ordinary precautions, "Ammate" X may be used close to such crops as cotton, tomatoes, soybeans and peanuts.

On all chemicals, follow label instructions and warnings carefully.

DU PONT
REG. U. S. PAT. OFF.

WEED and BRUSH KILLERS

BETTER THINGS FOR BETTER LIVING...*THROUGH CHEMISTRY*



THE SOLUTION: *Humble* RUST-BAN 231,

with exceptional rust-resistant qualities even up to 750° F.

Humble Rust-Bans are a complete line of protective coatings for every industrial use. Developed to meet the extreme corrosive conditions of the petroleum industry, the Rust-Ban line has been expanded for use wherever corrosion is a problem.

Ask Humble's Sales Technical Service staff to make recommendations which will be helpful to you. The right Rust-Ban may save you hundreds to thousands of dollars in corrosion damage. See the nearest Humble wholesale plant in Texas and New Mexico, or write or phone: Technical Service, Sales Department, Humble Oil & Refining Company, P. O. Box 2180, Houston 1, Texas.

HUMBLE

HUMBLE OIL & REFINING COMPANY

GET MORE PROFITABLE REFINERY OPERATIONS

with PETRECO® PROCESSING

PETRECO ELECTRIC DESALTING effectively reduces salts in the refinery crude charge to minimum or zero, and at the same time removes a high percentage of solids and fines.

PETRECO ELECTROFINING is a continuous, automatic, one-pass method for caustic scrubbing, acid contacting and water washing, with minimum product loss or chemical carry-over.

PETRECO ELECTROFINING—DOCTOR TREATING reduces carry-over drastically and provides substantial savings in lead, caustic, sulfur and inhibitor, while holding volume losses at minimum. The processing is continuous, automatically controlled.

PETRECO—BENDER PROCESSING sweetens gasoline, kerosine, jet fuel and No. 2 fuel with no product loss in the processing. Operation is reliable and simple. Catalyst need be rejuvenated only occasionally; easily accomplished at the plant site.

For complete information, write or call

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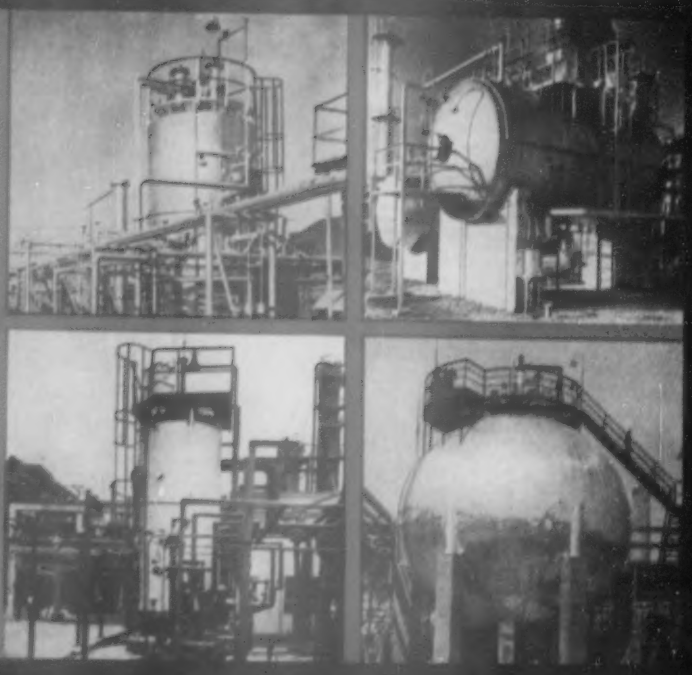
ARG-9



F-100 8-ft. Pickup—GVW 5,000 lbs.

T-800—GVW 42,000 lbs.; GCW 65,000 lbs.

Ford saves you money with

YOU SAVE ON PARTS REPLACEMENTS—*add miles to engine life!*

YOU SAVE ON SHOP LABOR—*cut maintenance to the bone!*

YOU SAVE ON YOUR ORIGINAL INVESTMENT—*get more work done per truck!*

Ford Trucks for '56 save you money right from the start. And, they keep on saving with their extra-sturdy, long-life engine design.

For instance . . . Ford Engineers have now introduced into all heavy-duty engines the greatest valve advancements ever. As an example, see the exhaust valve in diagram on right page. The valve stem is hollow and partially filled with powdered sodium. When the sodium gets hot, it *turns into a liquid.* As it moves up and down, it carries heat away from valve head—*allows it to operate up to 225° cooler!* Result: a cleaner-running, more burn-free, longer-lived valve face.

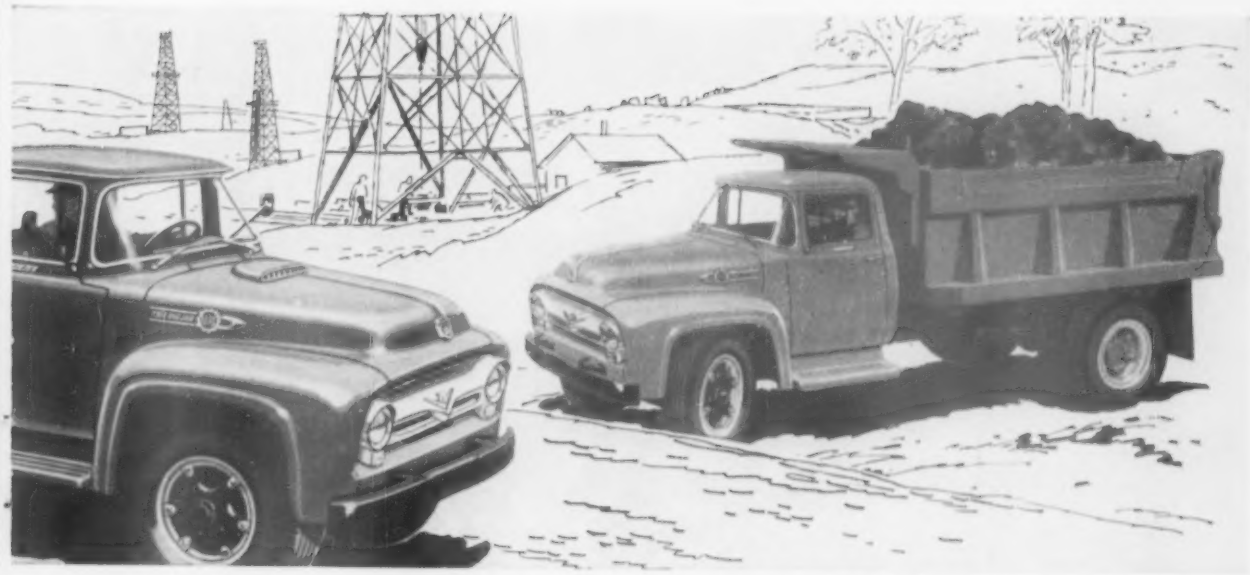
Ford's long-lasting engine design pays off for you in every way. You save money on parts replacements such as piston rings and bearings. You save on shop labor—extend time between preventive maintenance jobs like valve adjustments, valve grindings, compression tests, ring jobs and the like.

And you can save on driver costs if you can keep trucks out of the shop and on the road. Yes, you save in every way when you get more work done per truck!

There's a Ford Truck for every trucking job. Before you buy your next truck, Test Drive a Ford Economy Truck.

FORD TRUCKS LAST LONGER

Certified by independent insurance actuaries for the ninth consecutive year! Studies of over 10,068,600 current license registrations show that Ford Trucks last up to 9.9% longer than any of the other 4 leading truck makes!



F-900—GVW 29,000 lbs.; GCW 60,000 lbs.

new long-life engine design

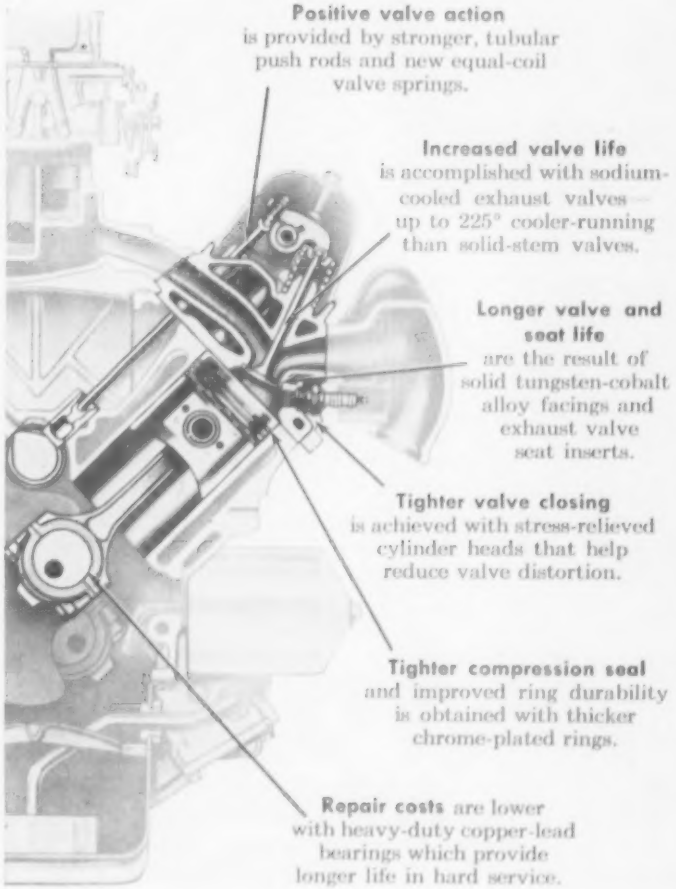
Hauls up to 3000 lbs. more than other 6-wheelers—New Ford T-800

● New power and hauling capacity of the Ford Tandem BIG JOB cuts hauling time on every run—makes giant cargos seem lightweight. You have a choice of two gas-saving Short Stroke engines. Either the 190-h.p. *Torque King* V-8 or, the 200-h.p. *Torque King* Special V-8.

You have new engine advancements for longer life (some explained and illustrated at the right).

New high-capacity tubeless tires, heavy-duty 5-speed transmission and Power Steering are standard equipment, at no extra cost. Two 3-speed auxiliary transmissions and full-air brakes are available at low extra cost.

New *Driverized* Cabs for driving comfort and convenience have *Lifeguard* Design safety features found in no other truck. Lifeguard steering wheel helps protect driver from steering column; Lifeguard door latches help keep doors from jarring open in case of accident.


Positive valve action is provided by stronger, tubular push rods and new equal-coil valve springs.
Increased valve life is accomplished with sodium-cooled exhaust valves—up to 225° cooler-running than solid-stem valves.
Longer valve and seat life are the result of solid tungsten-cobalt alloy facings and exhaust valve seat inserts.
Tighter valve closing is achieved with stress-relieved cylinder heads that help reduce valve distortion.
Tighter compression seal and improved ring durability is obtained with thicker chrome-plated rings.
Repair costs are lower with heavy-duty copper-lead bearings which provide longer life in hard service.

EATON *TANDEM DRIVE* AXLES

Give Trucks Greater Load Capacity— Reduce Tire and Operating Costs

Eaton Tandems are the most practical units available for increasing payload in proportion to gross weight. Eaton Axles—the load-carrying and driving components —are performance-proved by thousands of units and millions of miles of service. They are installed to operate in the position for which they were designed and, therefore, are not subject to abnormal stresses or to unnatural lubricating problems.

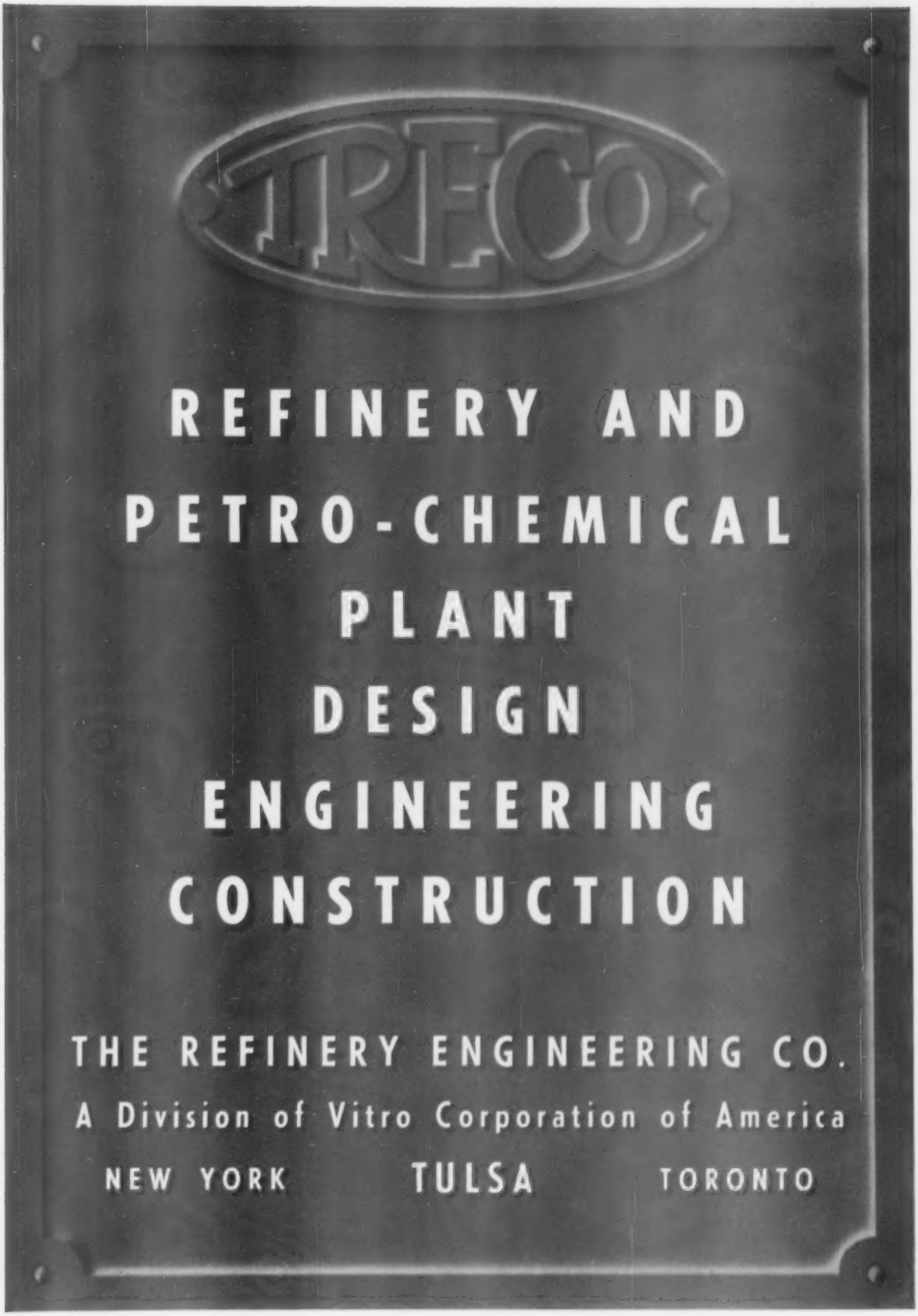
Exclusive Eaton features, simplicity of design, and rugged construction assure maximum performance with minimum maintenance.

Eaton Tandem Axle Features Provide Superior Performance

- Engineered specifically for tandem operation
- Rugged power divider transmits power equally to both axles
- Inter-axle differential compensates for variation in wheel speed and eliminates the need for tire matching
- Differential lock-out provides positive drive to each axle when needed
- Designed to give maximum strength with minimum weight

EATON *AXLE DIVISION*
MANUFACTURING COMPANY
CLEVELAND, OHIO

PRODUCTS: Sodium Cooled, Poppet, and Free Valves • Tappets • Hydraulic Valve Lifters • Valve Seat Inserts • Jet Engine Parts • Rotor Pumps • Motor Truck Axles • Permanent Mold Gray Iron Castings • Heater-Defroster Units • Snap Rings Springtites • Spring Washers • Cold Drawn Steel • Stampings • Leaf and Coil Springs • Dynamatic Drives, Brakes, Dynamometers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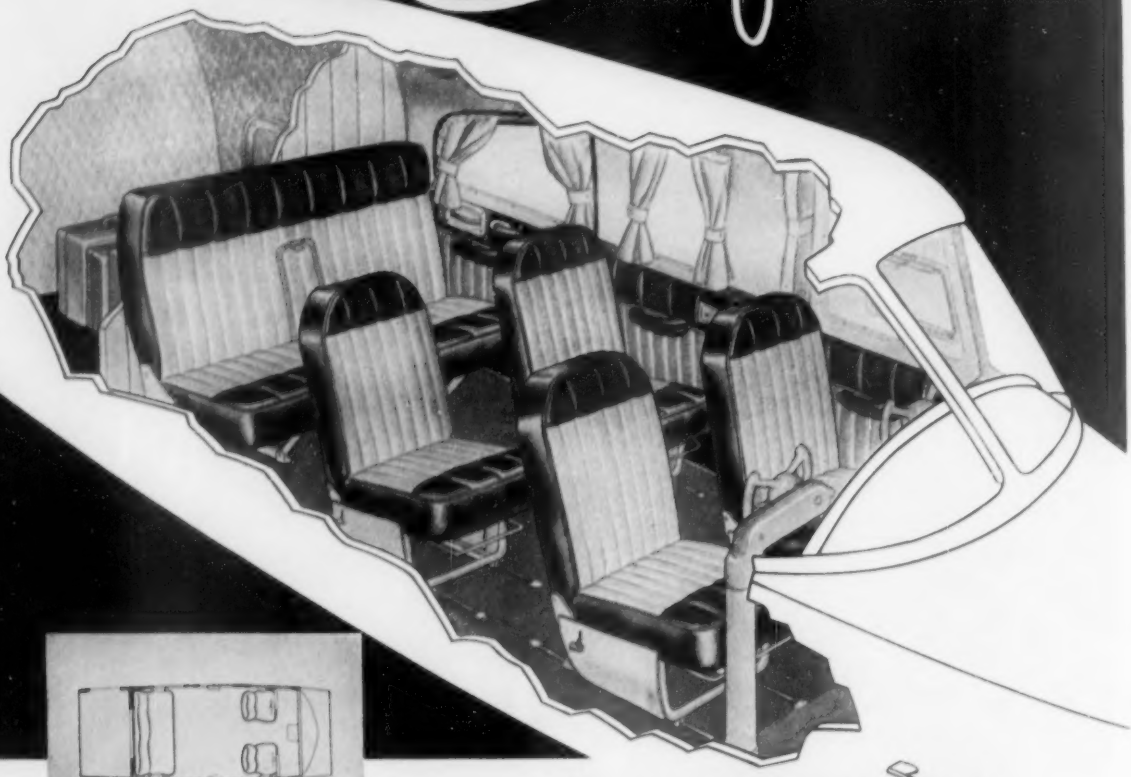
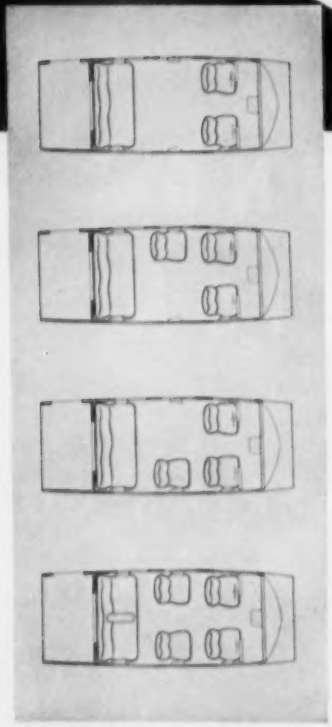
PLANT
DESIGN
ENGINEERING
CONSTRUCTION
THE REFINERY ENGINEERING CO.
A Division of Vitro Corporation of America
NEW YORK
TULSA
TORONTO

room to be comfortable





The spacious unobstructed floor lends itself to a multitude of customized cabin arrangements.

. . . in both great COMMANDERS

INDIVIDUAL BY-THE-WINDOW SEATS
ADJUSTABLE RECLINING CHAIRS
CONVENIENT CENTER AISLE
MOVE-ABOUT FREEDOM IN FLIGHT

The long, roomy 10¾-foot COMMANDER cabins are designed to give the executive maximum comfort and utility in his executive airplanes.

AERO Commander
560-A · 680-SUPER
WRITE FOR CATALOG 120-A WRITE FOR CATALOG 120-S

AERO DESIGN & ENGINEERING CO • TULAKES AIRPORT • P. O. BOX 118 • BETHANY, OKLAHOMA

They Say—

A Driller Speaks Up

Dear Sir:

Recently I had the pleasure of discussing with one of The Oil and Gas Journal representatives, the problems of the drilling contractors.

At that time, I commented to him that I was genuinely pleased in the interest that The Oil and Gas Journal has given to the drilling contractors. I have recently directed a letter to the I.P.A.A monthly magazine of which I am a committee member, suggesting to them some editorial material directed in the problems of the drilling contractor.

Being contractors and oil producers gives us a great advantage in understanding the problems of both sides.

I was particularly interested in your January 16, 1956, edition, where Mr. Robert J. Enright composed the article "Squeeze Hurts Drillers," page 63. The facts presented in his article were not only correct, but also fantastic. Fantastic in a way that it seems a shame that the oil industry would permit one of its elements to fall into the depths of a depression when the other elements seem to be having their most profitable operations.

My suggestion to your representative was that I felt The Oil and Gas Journal, being the "Bible" of the oil industry, should print articles concerning the contracting industry and its problems in each issue until such time that we obtain some relief. I am not only speaking from the side of the contractor, but also from the point of view of the operator in relation to the contractor.

It is my belief that the oil operator today, either of a major company or an independent, does not realize what it means when the contractors fold. It means simply one thing—that the major oil companies and the independent operators will have to buy their own rigs to do their own drilling.

It is true that the contractor hasn't handled the situation properly in the last few years. However, it is going to take the help of all the elements in the oil industry to pull the contractor on the profit side of the ledger.

Mr. Enright's article particularly interested me in the last few paragraphs:

"What's ahead—few contractors expect to do much better than they are now for the next year at least.

"Some think the present situation will gradually ease if 1955's trend of busier rigs continues for several years. Few rigs are being purchased now and

SWING JOINTS BARCO ASSEMBLIES

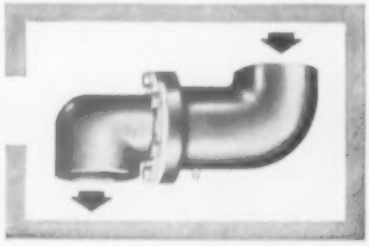
New Refinery

Barco Swing Joints are used for all of the 23 oil and gasoline tank car loading stations and the 5 LP Gas Stations in this new western refinery.

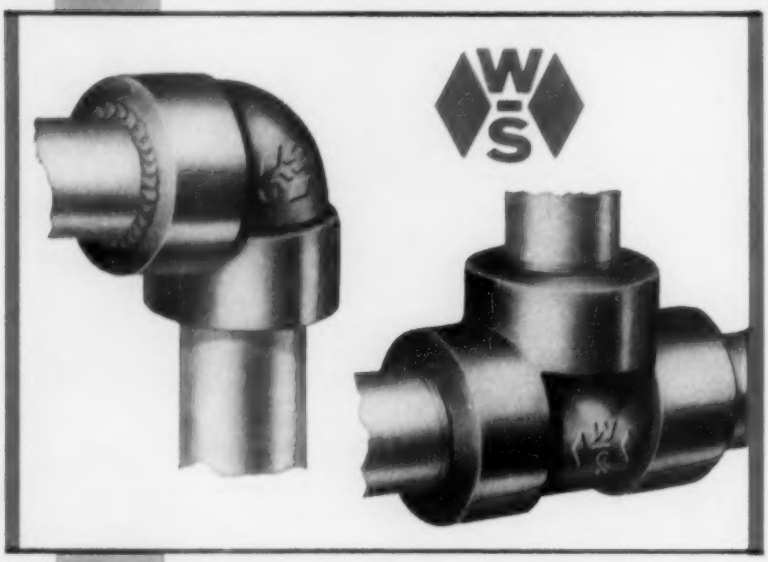
How Barco Makes Refinery Loading Racks Work Better!

1. **Controlled Torque**—Here is a feature users unanimously applaud in Barco's new Swing Joints—*no annoying, uncontrolled free swinging of lines.* They swing easily but stay put.
2. **Ball Bearing and O-Ring Equipped**—Designed specifically for handling gasoline, oil, lube oil, LP gas, and other fluids, including many chemicals, *without leakage.*
3. **Large Bearing Surface**—Barco's bearing design provides adequate support for lengths of piping. Minimizes bearing pressures and wear.
4. **Long Life**—New "Bar-Moly" dry lubricant process used by Barco gives a permanent anti-galling, corrosive-resistant finish to moving parts. This, combined with routine lubrication, insures longest possible maintenance-free service.
5. **Easy Maintenance**—Joints can be disassembled for inspection without disconnecting piping. O-rings are easily renewed in the field. Frequent greasing not required to maintain sealing.
6. **Custom Designed Installations**—Your Barco Representative will be glad to show you actual models of smooth-working, balanced assemblies and a wide choice of Barco custom designs. Choice of materials, including all-steel. Sizes 1", 1½", 2", 2½", 3", 4", 6", and 10"—eleven different styles of joints. Ask for Catalog 400.

BARCO
Manufacturing Co.
539-D NORTH HOUGH STREET
BARRINGTON, ILLINOIS
Worldwide Sales and Service



2 Safe Ways to PROTECT Pressure Piping...



W-S SCREW-END and SOCKET-WELDING FORGED STEEL FITTINGS

Pipe joints are potential trouble spots in high pressure piping systems. Change in direction of flow causes turbulence, erosion and vibration. Watson-Stillman fittings are made to absorb this type of punishment. They're drop-forged for strength and toughness and safety-factor designed for the protection of your piping.

Choose between a welded piping system and a screwed one to suit your needs. Then choose W-S Screw-End or Socket-Welding Fittings to join your pipe. They're available in sizes ⅛" to 4" for piping up to 6000 lb. W.O.G. class. For high temperature or corrosive service you can get W-S Forged Stainless and Alloy Steel Fittings, too. Send today for our informative catalogs.

W-S FITTINGS DIVISION

H. K. PORTER COMPANY, INC.
Roselle, New Jersey

many are being worn out. This should mean more holes for fewer rigs eventually . . ."

Some drastic steps are going to have to be taken before the year is out. We are going to have to have an immediate change. Otherwise . . . there will be so many crumbled drilling contractors that there will not be anyone around to pick up the pieces.

It is with our deep gratitude that your magazine has presented our problem, and I sincerely hope that you will continue and that you will investigate this matter from both sides and show the results to your readers.

Harry J. Schafer, Jr.
Executive Vice President
and Treasurer
Schafer Drilling Co.
Oklahoma City.

Point Cleared Up

Dear Sir:

Under personal on page 172 of your January 16, 1956, issue, there is stated . . . that Western Natural Gas Co., Houston, and Gulf States Oil Co. of Canada are subsidiaries of El Paso Natural Gas Co.

Western Natural Gas Co. is an affiliate of El Paso Natural Gas Co. and not a subsidiary. The Gulf States Oil Co. of Canada is a wholly owned subsidiary of Western Natural Gas Co.

Henry O. Weaver
Vice President and Treasurer
Western Natural Gas Co.
Houston.

Pitfalls of Controls

"Price controls will not work in a highly competitive business like oil marketing. If prices are pegged too high, the public would in effect be paying a subsidy. If prices are pegged too low, some would be forced out of business and the seeds of monopoly would be sown."

Herbert Willetts, vice president of Socony Mobil Oil Co., in address before Independent Oil Men's Association of New England, Boston.

Totalitarian Pattern

"Compulsory unitization is a confiscation of property rights and it follows a totalitarian pattern. The independents surely do not want anything like that in California. Voluntary unitization is quite another matter. It has been successfully accomplished in a number of fields in California."

E. G. Starr, Association of Independent Oil Producers, Los Angeles, in letter opposing proposed California conservation referendum.

GASO FLEXIBILITY + GASO ADAPTABILITY + GASO PORTABILITY

= THE ASSURANCE

Of a Bigger Return On Your Pump Investment

Count among all the other factors of Gaso leadership the amazing *flexibility* of Gaso Pumps. You'll find them in clean, well kept pump houses and in isolated, wind-swept desert locations. Wherever they are placed they do what they are designed to do with minimum attention and negligible maintenance. Delivering more capacity per pound of weight, they are adapted to a wide variety of uses. Their portability permits easy transfer from job to job. The result? Definite *assurance* of greater service, greater economy, greater return on the investment.

GASO PUMP & BURNER MFG. CO. TULSA, OKLAHOMA
EXPORT OFFICE 149 Broadway, New York

Be Sure With

GASO PUMPS
for every oil industry need

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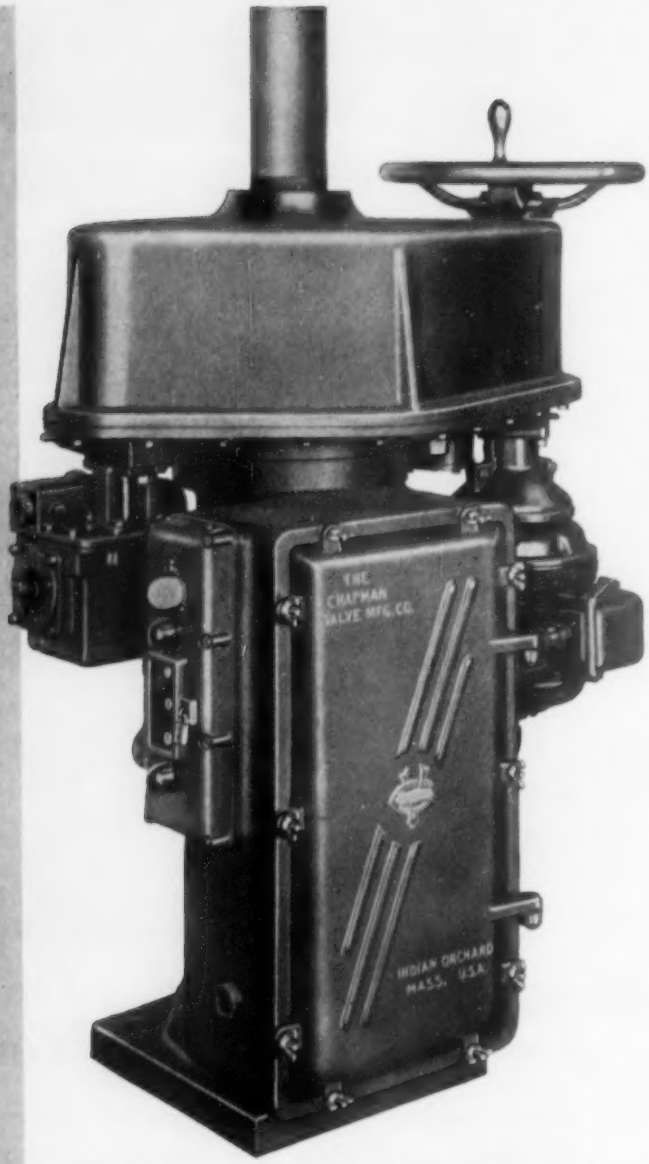
LUFKIN FOUNDRY & MACHINE CO., Casper, Wyoming
LUFKIN MACHINE CO., Ltd., Edmonton, Alberta

Fewer Parts Mean Greater Dependability

Floorstand Motor Unit . . . control panel, motor, limit switch and push button station.



Simple, durable mechanism of Chapman's Motor Unit. Handwheel remains stationary during motor operation.

IN CHAPMAN MOTOR UNITS

Chapman's simple and rugged Motor Unit gives accurate, trouble-free control of large valves and sluice gates. It has approximately *half as many parts* as any other unit. Its simplified design, low speed motors and low-ratio, stubtooth gears combine to give positive operation without drift, in *any* position and under all conditions.

Installation is fast and simple. The floorstand unit comes completely wired, ready to connect to leads. Limit switch has micrometer adjustment for exact pre-setting for seating tightness. Motor Units operate smoothly under the most adverse conditions. All units are weather-proof and steam-tight. Write today for *new* Catalog 51.

The Chapman Valve Manufacturing Co.

INDIAN ORCHARD, MASSACHUSETTS

CALENDAR OF EVENTS

MARCH

21-23 American Petroleum Institute, Division of Production, Southwestern District meeting, Texas Hotel, Fort Worth.

24 North Texas Oil and Gas Association, annual meeting, Wichita Falls, Tex.

29-30 American Institute of Mining, Metallurgical, and Petroleum Engineers, Dallas section, conference on economics and valuation, Statler-Hilton Hotel, Dallas.

APRIL

2-3 Petroleum Engineering Conference on electrical and radioactivity logging, University of Kansas, Lawrence, Kans.

3-5 Annual Corrosion Control short course, University of Oklahoma Extension Study Center, Norman, Okla.

4-6 American Gas Association, general management conference, Conrad Hilton Hotel, Chicago.

4-6 American Petroleum Institute, Division of Production, Mid-Continent District meeting, Broadview Hotel, Wichita, Kans.

4-6 Society of Lubrication Engineers, eleventh annual meeting and exhibit, Wm. Penn Hotel, Pittsburgh.

8-13 American Chemical Society, general meeting, Dallas.

9-10 Texas Petroleum Research Committee, Ninth Oil Recovery Conference (Symposium on Natural Gas in Texas), Texas A. & M. College, College Station, Tex.

11-13 Natural Gasoline Association of America, Texas Hotel, Fort Worth.

14-15 Southern Gas Association, conference on use of electronic computers by engineering personnel, Hilton Hotel, El Paso.

14-18 Petroleum Equipment Suppliers Association, annual meeting, Boca Raton Hotel & Club, Boca Raton, Fla.

15-17 Texas Independent Producers and Royalty Owners Association, Statler Hilton Hotel, Dallas.

16-18 American Society of Mechanical Engineers, first Gas Turbine Power Conference, Hotel Statler, New York.

17 American Institute of Chemical Engineers, Philadelphia-Wilmington section —University of Pennsylvania, fourth annual meeting of "Experience in Industry" series.

17-19 Southwestern Gas Measurement Short Course, University of Oklahoma, Norman, Okla.

18-20 American Petroleum Institute, Division of Production, Rocky Mountain District meeting, Cosmopolitan Hotel, Denver.

18-20 National Petroleum Association, semi-annual meeting, Cleveland Hotel, Cleveland, Ohio.

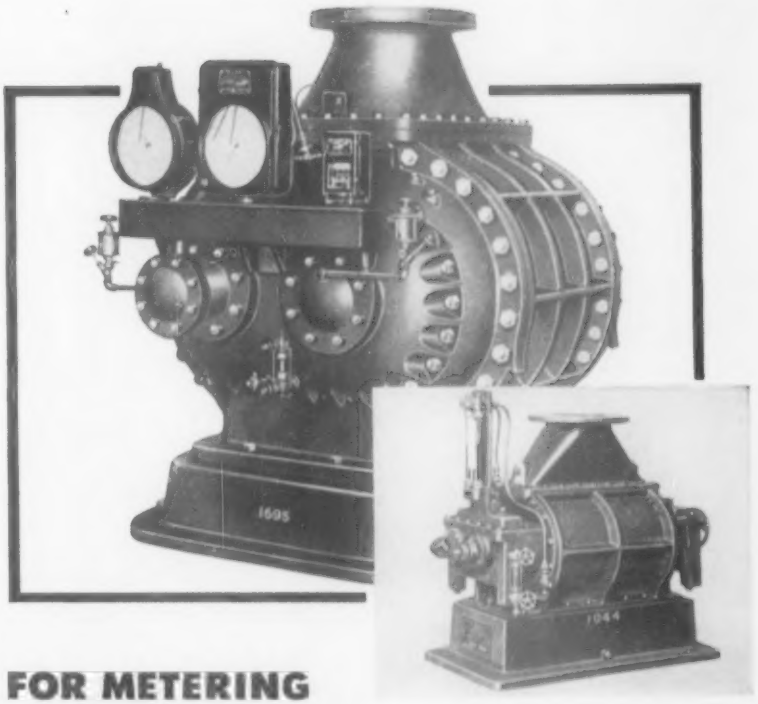
19-20 Third Annual West Texas Oil Lifting Short Course, Texas Technological College, Lubbock, Tex.

19-21 Gas Appliances Manufacturers Association, annual meeting, The Greenbriar Hotel, White Sulphur Springs, W. Va.

23-25 Southern Gas Association convention, Dallas.

23-26 American Association of Petroleum Geologists and Society of Economic Paleontologists, annual meeting, Conrad Hilton Hotel, Chicago.

24-25 Pacific Coast Gas Association, Supply



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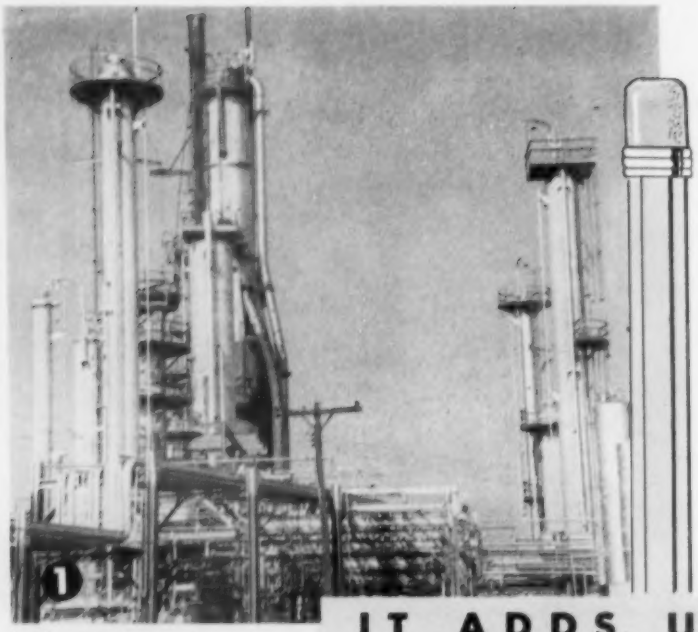

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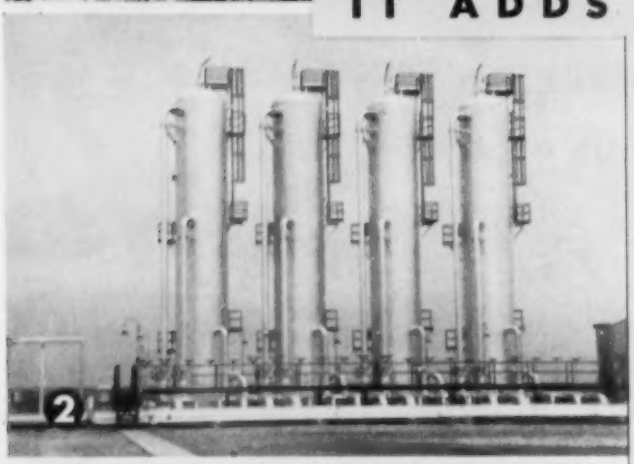

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and transmission conference, Thunderbird Hotel, Las Vegas, Nev.

25-29 World Oil Exposition, Houston.

25-27 American Petroleum Institute, Division of Production, Eastern District meeting, Deshler-Hilton Hotel, Columbus, Ohio.

26-27 Rocky Mountain Oil and Gas Association, refining committee, ninth annual meeting, Newhouse Hotel, Salt Lake City.

30

May 1 Independent Petroleum Association of America, semiannual meeting, Statler Hotel, Los Angeles.

30-

May 5 International Course on Atomic Energy, sponsored by National Industrial Conference Board, Westchester Country Club, New York.

MAY

1-3 Petroleum Industry Electrical Association, annual meeting, Statler-Hilton Hotel, Dallas.

6-9 American Institute of Chemical Engineers, Roosevelt Hotel, New Orleans.

7-8 Gas Compressors Institute session, sponsored by University of Kansas and Southwest Kansas petroleum industry, Liberal, Kans.

7-11 American Welding Society, annual spring meeting, Hotel Statler, Buffalo.

9-10 Symposium on control of corrosion in the chemical industry, University of Buffalo.

9-10 National Association of Corrosion Engineers, Niagara frontier section, symposium on control of corrosion in the chemical industry, University of Buffalo.

10-11 American Petroleum Institute, Division of Production, Pacific Coast district meeting, Statler Hotel, Los Angeles.

10-11 American Gas Association, Gas Supply, Transmission, and Storage Conference, Conrad Hilton Hotel, Chicago.

13-16 American Petroleum Institute, annual pipeline conference, Shamrock Hilton Hotel, Houston.

14-15 American Institute of Mining, Metallurgical & Petroleum Engineers, Kansas regional meeting, Broadview Hotel, Wichita.

14-16 Petroleum Electric Power Association, eighth annual convention, Robert Driscoll Hotel, Corpus Christi.

14-17 American Petroleum Institute, Division of Refining, midyear meeting, Montreal.

16-18 American Gas Association, Chemical Engineering, and Manufactured Gas Production Conference, Benjamin Franklin Hotel, Philadelphia.

17-18 Rocky Mountain Petroleum Sections, joint meeting, Gladstone Hotel, Casper, Wyo.

22-24 Pennsylvania Gas Association, Pocono Manor Inn, Pocono Manor, Pa.

24-25 Natural Gas and Petroleum Association of Canada, Sheraton Brock Hotel, Niagara Falls, Ont.

24-25 Kentucky Oil and Gas Association, annual meeting, Lafayette Hotel, Lexington, Ky.

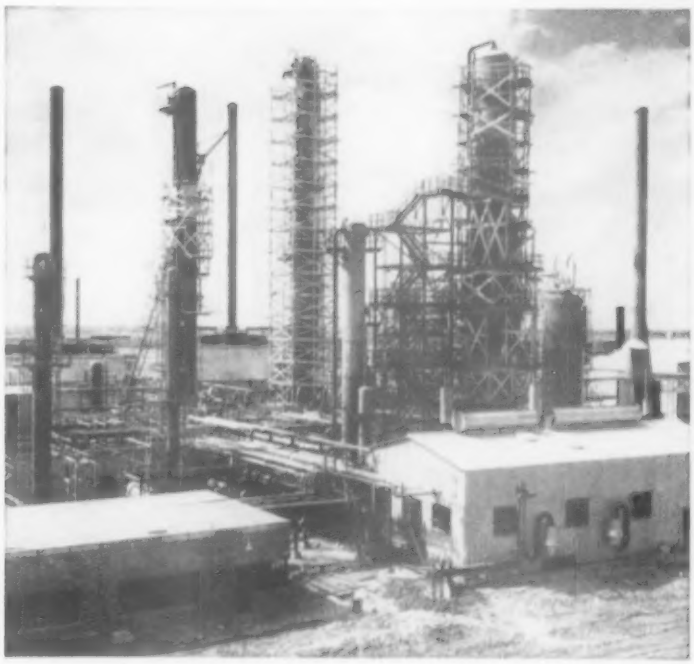
24-25 Western Petroleum Refiners Association, Michigan Regional Meeting, (location to be announced).

28-30 Chemical Institute of Canada, 39th annual conference and exhibition, Sheraton-Mount Royal Hotel, Montreal.

30-

June 1 Texas College of Arts & Industries, eleventh annual short course in Gas Technology, Kingsville, Tex.

New forests are growing in Western Canada



Forests of steel and concrete now tower over the level plains of Western Canada as refineries have sprung up to convert crude oil to the needs of industry, and capitalize on the vast wealth of Canada's petroleum resources.

If your own interests include Canadian oil, in any of its aspects from exploration and drilling equipment to refineries and pipelines, it will pay you to make use of The Canadian Bank of Commerce. More than 150 of our branches are located in the western Canadian oil fields. The men in our Petroleum and Natural Gas Department in Calgary are well versed in the problems encountered by United States and Canadian companies active in that area.

For further information, write to our Business Development Division, Head Office, Toronto 1, Canada—or direct to our Petroleum and Natural Gas Department, 309-8th Avenue West, Calgary, Alberta.

(We do not advise on the merits of specific oil securities)

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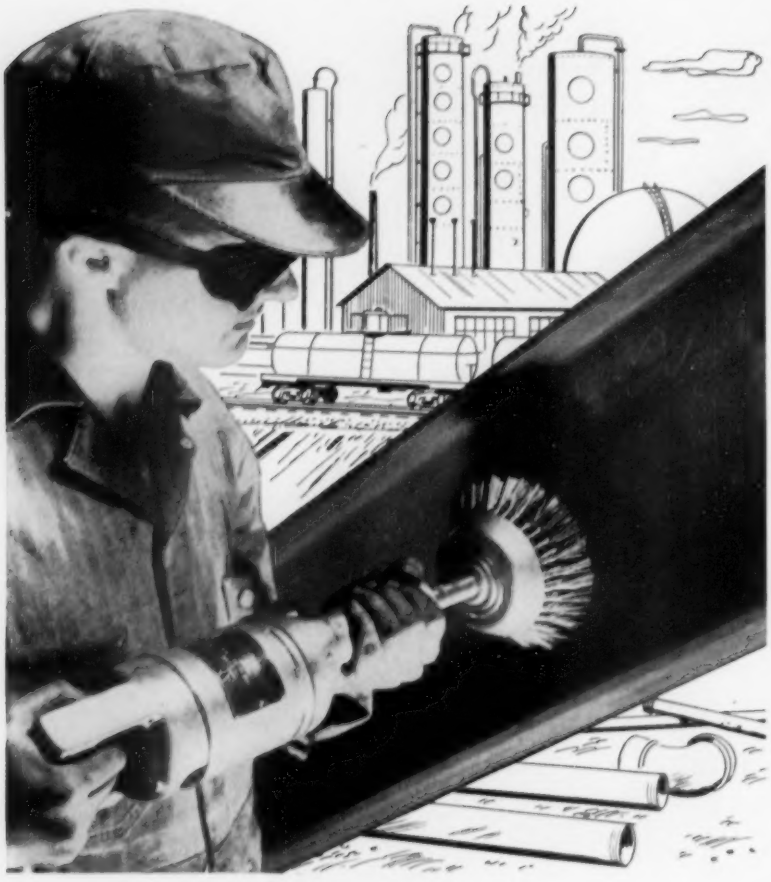

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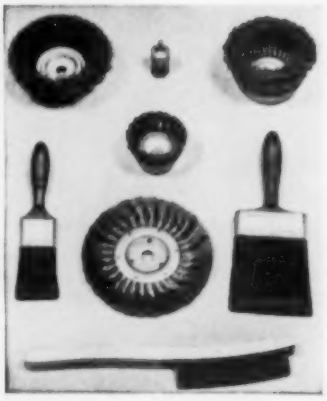
HIGH speed Osborn power brushes take all the effort out of cleaning rust, scale and old paint from large metal surfaces. Rugged, special analysis wire quickly bites through the most stubborn rust and other surface crusts . . . keeps brushes in service longer.

For information on Osborn's complete line of top-quality industrial brushes, write for Catalog 210-B. *The Osborn Manufacturing Company, Dept. N-4, 5401 Hamilton Avenue, Cleveland 14, Ohio.*



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30-June 2 Interstate Oil Compact Commission, Dallas.

JUNE

3-8 Society of Automotive Engineers, summer meeting, Chalfonte Haddon Hotel, Altantic City, N. J.

6-8 American Society for Quality Control, tenth annual convention, Palais du Commerce, Montreal.

11-15 American Institute for the Advancement of Science, Gordon Research on Conference on Catalysis and Petroleum, Colby Junior College, New London, N. H.

13 Pennsylvania Grade Crude Association, thirty-third annual meeting, Bradford, Pa.

17-22 American Society for Testing Materials, annual meeting, Chalfonte-Haddon Atlantic City, N. J.

17-23 World Power Conference, Vienna.

21-22 Western Petroleum Refiners Association, regional technical—industrial relations meeting, Broadview Hotel, Wichita.

21-23 American Association of Petroleum Landmen, annual convention, Denver.

24-25 Canadian Gas Association, Manoir Richelieu, Murray Bay, Que.

26-29 Canadian Gas Association, Manoir Richelieu, Murray Bay, Que. (see book).

28-30 Rocky Mountain Oil and Gas Association, board of directors, Hotel Utah, Salt Lake City.

SEPTEMBER

11-13 Pacific Coast Gas Association, annual meeting, Coronado, Calif.

13-15 Chemical Institute of Canada, third Western Regional Conference, Edmonton, Alta.

17-21 Instrument Society of America, eleventh annual international instrument-automation conference and exhibit, New Coliseum, New York City.

20-21 Western Petroleum Refiners Association, regional technical-industrial relations meeting, Hotel Henning, Casper, Wyo.

20-21 Mid-Continent Oil and Gas Association, Louisiana-Arkansas division, annual membership meeting, Roosevelt Hotel, New Orleans.

OCTOBER

7-9 American Association of Oil Well Drilling Contractors, annual meeting, Texas Hotel, Fort Worth.

14-17 American Institute of Mining, Metallurgical & Petroleum Engineers, Petroleum Branch, fall meeting, Biltmore Hotel, Los Angeles.

15-17 American Gas Association, annual meeting, Atlantic City, N. J.

18-19 Western Petroleum Refiners Association, regional technical-industrial relations meeting, Rufus Garrett Hotel, El Dorado, Ark.

22-24 Rocky Mountain Oil and Gas Association, annual convention, Cosmopolitan Hotel, Denver.

29-Nov. 1 Society of Exploration Geophysicists, national convention, New Orleans.

NOVEMBER

12-15 American Petroleum Institute, annual convention, Conrad Hilton Hotel, Chicago.

19-20 American Institute of Mining, Metallurgical & Petroleum Engineers, North Texas Secondary Recovery Symposium, Municipal Auditorium, Wichita Falls.

25-30 American Society of Mechanical Engineers, Statler Hotel, New York.

W. HORACE WILLIAMS CO., INC. DOES IT AGAIN!

An oil company suffered the loss by fire of 630 feet of loading wharf. It was discovered that the lower portions of piles were still sound. A unique design of steel frames, supported by sound portion of piles, was employed. A concrete deck was poured over the steel frames. This resulted in a considerable saving and at the same time gave the resultant structure a fire-resisting construction. W. Horace Williams Co., Inc. engineering skill and know how saved this company considerable money!

Scene at left shows the river with the reconstructed fire-damaged portion of wharf. Notice the steel frames above old piles and the concrete deck.

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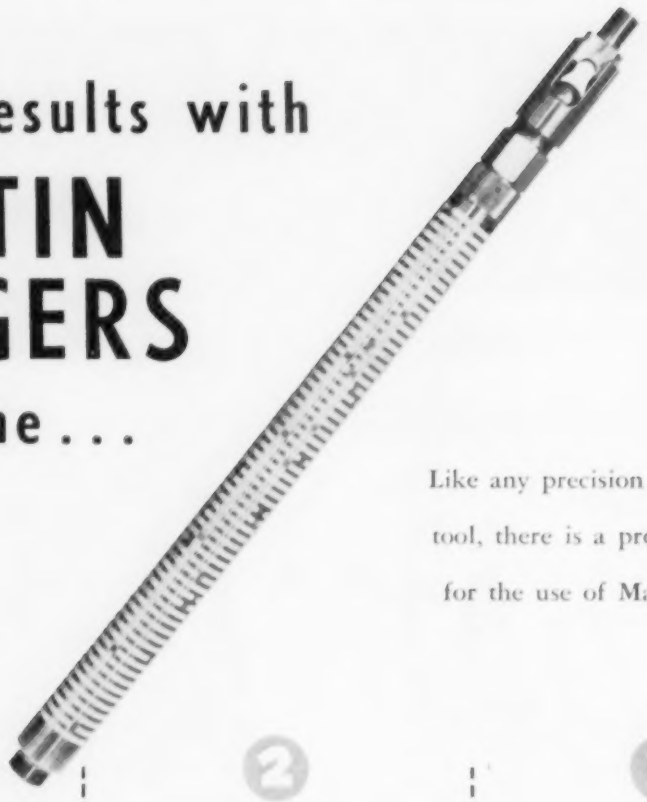

Like any precision instrument or tool, there is a proper technique for the use of Martin Plungers.

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The deeper the well the longer the plunger required. Three rings per 100 ft. for the 1¼" and smaller diameters, and two rings for the larger diameters, is simple rule to follow. Add extra length for stroke-thru.

2

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3

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Complete, detailed instructions for using Martin Plungers are given simply and quickly in John N. Martin Catalog No. 4. All guess work is eliminated. You obtain proper ring size for a correct working fit, proper plunger length for your particular well, and proper pre-swelling of rings. *It's a fact: — you have perfect results with Martin Plungers everytime — regardless of water or sand conditions — when you follow the simple instructions in John N. Martin Catalog No. 4. Write for it today.*

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TULSA, OKLAHOMA

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JOURNALLY SPEAKING . . .

Octaneously Speaking

WANT to make 100 octane? Everybody will be doing it in a few years, according to George Weber's article in this issue. The Journal's refining editor sticks his neck way out with some amazing predictions of things to come in the demand for motor fuel and how to meet it.

After you read that you may feel the urge to jump into the octane race. It's easy. We show you how right in this issue.

First, unfold the inserted four-color wall chart showing a model flow diagram for a 100-octane refinery. Then, study the descriptions of 42 different processes illustrated in our special process section and select the ones you like best for the various steps on the chart. After that, all you need is a few million dollars and you're in business.

P.S.—If you're already in the refining end and all mixed up in the big middle of the octane race, you'll want to study this material even more carefully. It'll give you some good dope on where you go from here. That's what it's for.

Futuristically Speaking

ALL the technical stuff in this issue is about making motor fuels today. George Weber's think piece is about motor fuels tomorrow. What about the day after tomorrow? Got to look way ahead in this business, y' know.

For instance, not a word is said about atomic energy. We'll agree that there is little prospect that atomic energy will displace gasoline. That prospect, which jumped into the assumptions of the general public a few years ago, now seems pretty remote. But what about the prospect that atomic energy will displace present methods of making gasoline? That's not quite so remote.

We have it on good authority (our favorite oil publication to be exact) that quite a few research labs of the bigger oil companies are experimenting with betatrons, cyclotrons, neutron accelerators, space guns, and other sorts of atomic-ray machines to see what happens when their unseen emanations whack up against hydrocarbon in its various combinations. From what little has leaked out from the mystery-shrouded inner confines of these research cells it may be deduced that these invisible bombardments disturb the hydrocarbons no end and that in their agitation they may redistribute their components into interesting new arrangements. Thus some entirely new types of motor fuel or what have you may be produced by such methods some day.

The current issue of the Big Yellow Book is not the place to speculate about such remote possibilities because (outside of this department) it is devoted to what refiners are doing right now or may do in the next couple of years to stay on the octane treadmill.

But if you want to be informed on atomic refining methods if, as, and when they do come along, just keep sending your money for this magazine with full confidence that our staff (or maybe it will be our sons or grandsons) will dig out the dope and report it for you.

Nostalgically Speaking

PRESENT refinery methods may or may not be made obsolete by atomic gadgetry, but the march of progress is already crowding out one time-honored occupation: sweatermen. Not sweater girls; sweatermen. K e e p your mind on the subject.

Sweatermen, of c o u r s e, are men who operate sweaters. And in a refinery a sweater is an apparatus that sweats the wax out of lube-oil stock. Or used to. Nowadays many refineries have installed improved devices for extracting the solid-phase constituents from the liquid-phase material. Hence no more sweaters. Hence no more sweatermen. Gradually the sweatermen are being retired or put on other jobs. You don't hardly find none no more.

We don't know what they call the men who operate the new types of dewaxing mechanisms. Probably extraction engineers, or something equally high toned. We'll bet it's not nearly as colorful as sweatermen.

Now as to y o u r question about sweater girls, we have seen nothing to indicate that they are becoming obsolete. We have serious doubts that science, for all its marvels, will ever come up with any completely acceptable substitute.

—*Henry D. Ralph.*

Your motor fuel will not hold its full measure of pep without *RETAINED VOLATILITY*

Blend WARREN NATURAL GASOLINE with your present high quality motor fuel to give it superior performance after it reaches your customers' fuel tanks!

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The octane race is ahead of itself

IN the octane race of the last few years, refiners have outrun automobile designers. Result: It's being discovered, by motorists as well as by fuels experts, that many cars on the road aren't able to get full value and performance out of the highest-octane gasolines.

The spread between the laboratory rating of a gasoline's power (octane numbers) and motorists' actual experience is growing wider. This causes many drivers to doubt oil-company advertising claims.

Part of the blame lies with Detroit for making cars that operate best on fuel of only one specification—a specification that varies among makes and among individual engines off the same production line. But refiners are equally to blame for making gasolines with a road performance far below their lab ratings.

OCTANES ARE STILL CLIMBING. General opinion is that they will rise 2 numbers this year and reach 100 in a couple of years. But the push for this is not coming from automobile manufacturers. Nor is it coming from motorists except as they are influenced by advertising claims rather than by performance tests.

It's the competitive race of gasoline marketing and advertising men that keeps boosting octane above the ability of cars to use it. Detroit shows few signs of bringing out many cars that really need such high octane for several years. Refiners are out of step with their customers.

The modern automobile needs fuel that is a lot more than just octane numbers. It needs a complex compound of organic chemicals especially manufactured and blended for its particular requirements. At present neither automotive designers nor chemical engineers know exactly what the ideal specifications should be, but both are working on the problem.

So, when they can get their attention off mere octane numbers, refiners are looking more into the chemical characteristics of their gasoline and into its actual performance in cars of various makes and under various driving conditions.

A GOOD OPPORTUNITY is thus opened for independent refiners, those who don't feel compelled to keep up with the national octane-advertising competition. If they can learn more about the chemical constituents and the road behavior of their product they have a chance to win favor with the owners of today's cars.

There will be plenty of time to see what Detroit's designers are going to come up with before rushing pell-mell into expensive equipment to make fuel for a hypothetical car of tomorrow.

Dowell engineers tailor Sandlock treatment to your well after thorough study of well information.

SANDLOCK

shuts out sand with plastic-coated walnut shells

SANDLOCK*, an exclusive new Dowell service, creates a permeable network of crushed walnut shells coated with plastic to control unconsolidated sand.

In a Sandlock treatment, crushed, graded walnut shells are coated with unset plastic. The coated shells are mixed into oil and displaced into the formation. The plastic hardens, forming a strongly consolidated, highly permeable network that needs no retaining screens or liners. Working time can be varied from 1 to 15 hours. Shut-in time is normally less than 24 hours.

In tests, Sandlock networks have shown tensile and compressive strengths comparable to sandstone and virtually complete resistance to sand erosion. Tests also indicated that a Sandlock network will prevent the production of all sand that is retained on a 140 mesh standard sieve.

If incompetent sand is hindering production from your well, talk it over with a Dowell engineer. For Sandlock service, or for more information, call any of the 165 Dowell offices in the United States and Canada; in Venezuela, contact United Oilwell Service. Or write Dowell Incorporated, Tulsa 1, Oklahoma, Department C-11.

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The Industry This Week

Refining

• **U. S. Refiners had a big year** in '55, but an even bigger one is ahead. This is pointed up by the Journal's annual refining survey. It shows: Crude capacity will be added at a faster rate, recycle to cat crackers is rising, cat reforming will approach 14 per cent of crude capacity by year's end, hydrogenation will expand 50 per cent, and alkylation shows signs of a comeback. What's more, the small refiners seem to be more than holding their own in spite of harsher competition. P. 114.

Canadian construction will continue at a rapid clip, too. Refiners are straining to keep up with the demand of an expanding economy. P. 117.

There's speculation Sun may be the first to bring out 100-octane gasoline. It's an outgrowth of Sun's Florida experiment of selling five grades. The 100 octane is reportedly the most popular. P. 125.

Industry

• **New highs in reserves** are reported for crude oil, natural gas, and gas liquids. The annual joint A.P.I.-A.G.A. report lists the 1955 crude increase at 451.4 million barrels, smallest since 1945; gas increase at nearly 12 trillion cubic feet, largest since 1946; and liquids addition at 194.1 million barrels, about equal to 1954 loss. P. 122.

A general increase in crude prices is talked more and more. Continental's McCollum says one's definitely on the way. A consultant reports finding costs have risen to $2 a barrel. P. 128.

Steel supply is tighter than it has been in years, perhaps the tightest in history. Some mills are booked up for 2 years on line pipe. Oil companies can't get nearly as much oil-country tonnage as they want. But they don't fear a shortage which would curtail drilling or construction. P. 130.

Production

• **The idea** of cutting the flow from shutdown-exempt fields is being pondered by the Texas Railroad Commission. The plan would permit an 8 per cent increase in allowables for other fields, according to Humble engineers. P. 120.

An American firm, Forest Oil Corp., may undertake a water-flood operation in the fabulous De Mares concession of Colombia. Forest is negotiating for a contract involving the La Cira and Infantas fields. P. 135.

Pipelining

• **Alberta natural gas for U. S. Midwest** markets by another route is proposed by Northern Natural. It wants to export 300 million cubic feet daily from Savanna Creek and Pincher Creek through a 1,215-mile line to Minneapolis. P. 118.

Supplies for Trans-Canada are nearly signed up. California Standard and Home Oil are the latest producers to dedicate natural-gas reserves to the line. P. 119.

Exploration

• **The world's deepest oil zone** has been squeezed. Richardson & Bass now will run a patch string of 5-in. casing in its Louisiana wildcat before perforating to test the sand between 21,523-622 ft. P. 127.

A rush to get drilling equipment to Somalia before the monsoon season is under way. The exploratory program on Africa's east coast will be undertaken by four American companies with Sinclair as operator. P. 134.

The Next Year in U.S. Refining . . .

	Crude	Vacuum	Thermal Cracking	Cat Cracking
Total Capacity 1/1/56	8,958,175	2,392,683	2,355,318	3,709,332
Construction 1956*	432,810	111,385	131,381	321,985
Total Capacity 1/1/57+	9,390,985	2,504,068	2,486,699	4,031,317
Construction 1957	85,250†	18,500	14,700	77,800
Total Capacity Early 1957+	9,476,235	2,522,568	2,501,399	4,109,117

Crude capacity up nearly 5%

* Correcting for 3 refineries scheduled to shut down during the year.
† Including 2 units not reported. (9,200).

Growth, Quality Keys to '56 Activity

George Weber

TWO important developments will highlight refining activity in the United States this year.

Refiners will add basic crude processing capacity at a higher rate than last year. And, they'll be busy adding units which will not affect crude capacity but which will greatly improve product quality.

These trends are emphasized by The Oil and Gas Journal's annual refining survey (page 213) which shows:

. . . **Crude capacity** will rise nearly 5 per cent this year after an increase of 3.8 per cent last year.

. . . **Recycling to cat crackers** is rising. It is now equal to about 33 per cent of the fresh feed and will continue to increase.

. . . **Catalytic reforming** passed 10 per cent of crude capacity at the first of the year and will approach 14 per cent by year's end.

. . . **Hydrogenation** looks like a new workhorse for the industry. Capacity jumped 270 per cent last year and will go up nearly 50 per cent more this year.

. . . **Alkylation** is showing signs of revival—this time for motor-fuel upgrading.

. . . **Small refiners,** as a class, are more than holding their own.

In spite of the pressure on refiners to keep up with their competitors on octanes, this year looks like a good one for the industry. An increase of 4 per cent is in prospect for gasoline demand.

The national weighted octane average rose 2 research numbers for both premium and regular last year. It is expected to go up another 2 numbers this year. This probably will come from competition within the industry and not from demands from auto makers. But nonetheless it will permit car makers to increase compression ratios still further next fall.

New light on cat cracking . . . This year for the first time the extent of recycling being done in U. S. and Canadian refineries is revealed.

In response to suggestions from the industry, the Journal survey asked refiners to report what per cent of total reactor capacity is represented by recycle streams on an average year-round basis. Cooperation was excellent. Complete returns were made by all but 4 of the 190 companies reporting.

For individual refineries, recycle to cat crackers ranges from zero to over 60 per cent of total feed. All reported data indicate that 23.6 per cent of total feed, or nearly 30 per cent of fresh feed capacity, is used for recycling catalytically cracked stocks to reactors.

The recycle ratio is rising. This is revealed in reports on new catalytic cracking capacity being completed this year. They indicate this new capacity will be operated at a recycle rate of about 32 per cent of total feed and 47 per cent of fresh feed. This will bring the national average up about 0.6 per cent on total feed and 2.0 per cent on fresh feed.

The ratio of total catalytic cracking capacity to crude continues to rise from 38.0 per cent at the beginning of 1955, to 41.5 per cent this year and about 43.0 per cent at year's end.

Cat reforming popular . . . The industry is continuing its swing to catalytic reforming in a big way.

Standing at 10.4 per cent of total crude capacity at the first of this year, cat reforming capacity will rise to 13.7 per cent by the year's end. This boost reflects addition of new reforming operations to many refineries and a second round of construction which has begun in several other plants.

Of the 157 refineries of 25,000 bbl. per day capacity or over, all but 30 have catalytic reforming. And 16 of these will be equipped this year. Catalytic reforming has long been practiced on a large scale by smaller refineries who were the first to adopt the process.

There's a wide choice of catalytic reforming processes for the refiner to choose. Altogether, 12 distinct processes are now in operation, and a thirteenth will make its debut this year. Fixed-bed processes continue to dominate the field. All existing operations are still on a once-through basis. But Rexforming will come into operation this year to change that. It will provide for extraction and recycle of lower-octane components of reformate.

As pressure for higher octanes requires more severe reforming, processes providing both recycling and catalyst regeneration in place are expected to gain in favor. Look for new developments this year and next on regeneration of catalyst in units without interruption of operations.

Hydrogen treating a comer . . . Refiners are fast adopting the technique of hydrogen treating of all kinds of stocks.

Last year, this technique caught on

Millions for new reforming

watch alkylation move—

Cat Reforming	Hydrogen Treating	Alkylation	Polymerization	Lubes	Coke	Asphalt
926,469	433,005	263,409†	141,650	186,151	10,882	379,390
349,685	200,600	14,700	615	2,600	550	3,750
1,281,154	633,605	278,109	142,265	188,751	11,432	383,140
66,785	116,585	15,850	2,500	380	825	3,200
1,347,939	750,190	293,959	144,765	189,131	12,257	386,340

Hydrogen treating catching on FAST

‡ Not including 70,000 bpd. in planned but uncommitted refineries.
† Estimated.

The 'Independents' Are:

. . . Gaining in capacity . . . competing on cat cracking . . . and holding their own on cat reforming.

	Companies controlling over 100,000 B.P.S.D.			Companies controlling less than 100,000 B.P.S.D.		
	1-1-55	1-1-56	1-1-57*	1-1-55	1-1-56	1-1-57*
Number of companies	19	20	20	157	156	157
Number of refineries	119	120	120	183	188	189
Crude charging capacity	7,044,080	7,311,895	7,642,995	1,595,175	1,646,280	1,747,990
Per cent of annual change	+3.9	+3.8	+4.5	—4.3	+3.2	+6.5
Per cent of U. S. total	81.5	81.6	81.3	18.5	18.4	18.7
Cat cracking capacity	2,834,830	3,049,297	3,326,982	446,020	660,035	704,335
Per cent on crude	40.2	41.8	43.5	28.0	40.1	40.4
Cat reforming capacity	427,530	758,512	1,044,797	141,800	167,957	236,357
Per cent on crude	6.1	10.4	13.7	8.9	10.2	13.6
Hydrogen treating capacity	109,500	382,845	558,545	7,750	50,160	75,060
Per cent on crude	1.6	5.25	7.3	0.5	3.4	4.3
Alkylation capacity	218,334	230,659	243,359	19,094	32,750	34,750
Per cent on crude	3.1	3.2	3.2	1.2	2.0	2.0
Polymerization capacity	100,234	101,213	101,088	34,585	40,437	41,177
Per cent on crude	1.4	1.4	1.3	2.2	2.5	2.4

*Estimated.

Source of Figures . . .

TABLES in this report are based on The Oil and Gas Journal's Annual Refining Survey which begins on page 213. This survey reflects the status of the United States and Canadian refining industry as of January 1, 1956

A second survey of new construction begins on page 248. This information, also submitted by individual companies, is used to project capacity to January 1, 1957, and beyond. All figures represent capacity expressed in barrels per stream day.

In the past the estimation of capacity for the end of the current year has proved conservative. The same may be true this year. The estimated figures for January 1, 1957, may include some unannounced plant shutdowns during 1956. They will not include numerous increases in capacity which result from bottleneck removal and other means.

The figures in these tables agree with the basic survey in all categories excepting alkylation, where they include two units which were not reported but are known to exist.

rapidly with the building of new units with over 300,000 bbl. per day total capacity. Here too, the field is broadening processwise. Five new versions were put into operation last year and three more will find initial use before another year is gone.

Refiners are using this valuable treating tool for cleaning up everything from reformer feed to lubricating oil and wax. Many refineries now have hydrogen treating capacity exceeding 20 per cent of crude capacity. The present level of 4.8 per cent on crude is certain to rise. By the end of the year, hydrogen treating capacity will represent 6.7 per cent of total crude capacity.

Eventually, hydrogen treating capacity may reach 30 to 40 per cent of crude capacity, as refiners adapt it to remove sulfur, nitrogen, unsaturates and metallic contaminants from intermediate streams and finished products.

Alkylation Up . . . One direct effect of higher octanes is the increase in alkylation capacity.

At this time, with aviation gasoline demand relatively static, new units and much existing capacity will be devoted to producing the much-desired components of motor fuel. By the end of 1957, total capacity is expected to top 300,000 bbl. per day, a 25 per cent increase over last year.

Thermal operations dip . . . The decline in thermal cracking continues. Capacity would fall off more sharply were it not for the increased adoption of coking.

At the first of this year, coking accounted for 14 per cent of total thermal capacity. It is expected to represent roughly 20 per cent by the end of 1956. Visbreaking and other residuum cracking except coking stands at about 29

Cat Cracking . . .

. . . The ratio to crude capacity is still climbing.

(Barrels per stream day)

Type—	1-1-54	1-1-55	1-1-56	Estimated 1-1-57	Estimated early 1957
Fluid	1,940,702	2,362,830	2,694,312	2,998,947	3,051,047
T.C.C.	602,919	652,700	733,520	753,420	779,120
Houdriflow	105,000	123,020	203,800	203,800	203,800
Houdry F.B.	163,390	128,550	55,300	43,500	43,500
Cycloversion	17,850	13,750	22,400	22,950	22,950
Undisclosed				8,700	8,700
Total	2,829,861	3,280,850	3,709,332	4,031,317	4,109,117

Cat Reforming . . .

. . . The second round on building is now under way.

(Capacity, barrels per stream day)

	1-1-54	1-1-55	1-1-56	Estimated 1-1-57	Estimated early 1957
Platforming	107,192	277,690	525,472	616,222	632,422
Ultraforming		24,750	103,150	159,150	166,750
Hydroforming, Fluid	2,000	61,450	61,450	61,450	61,450
Houdriforming	23,540	28,540	58,220	106,470	106,470
Hydroforming, F.B.	71,100	67,300	42,865	42,865	42,865
Catforming	20,010	42,550	39,612	54,597	69,582
Sinclair-Baker		19,000	37,000	78,000	82,000
Thermofor, C.R.		19,000	35,000	35,000	35,000
Sovaforming		9,000	9,000	83,000	95,000
Cycloversion	25,250	19,050	8,200	8,200	8,200
Powerforming			5,500	8,300	8,300
Hyperforming		1,000	1,000	1,000	1,000
Rexforming				10,900	16,900
Undisclosed				16,000	22,000
Total	249,092	569,330	926,469	1,281,154	1,347,939

Hydrogen Treating . . .

. . . A new process with versions appearing everywhere.

(Capacity, barrels per stream day)

	1-1-55	1-1-56	Estimated 1-1-57	Estimated early 1957
Unifining (U.O.P.-Union Oil)	30,250	205,005	237,890	263,875
Hydrofining (Esso)	60,000	113,800	113,800	113,800
Hydrofining (Indiana)		34,600	65,100	87,700
Vapor Phase Hydrodesulfurization (Shell)	23,000	31,000	47,000	47,000
Hydropretreating (Houdry)		13,500	13,500	13,500
Hydrotreating (Texaco)		11,100	18,315	18,315
Hydrodesulfurization (Sinclair)		10,000	10,000	10,000
Hydrodesulfurization (Phillips)		10,000	10,000	10,000
Hydrodesulfurization (Kellogg)	3,000	3,000	3,000	3,000
Diesulforming (Husky)	1,000	1,000	1,000	1,000
Gulfining (Gulf)			80,000	80,000
Hydrodesulfurization (Ashland)			8,500	8,500
Sovafining (Socony-Mobil)				68,000
Undisclosed			25,500	25,500
Total	117,250	433,005	633,605	750,190

Coking increasing . . .

	Cap., bbl. per stream day— Delayed	Batch	Fluid	Total
1-1-55	243,800	35,290	3,800	282,890
1-1-56	296,500	27,290	13,800	337,590
1-1-57 (est.)	308,700	27,290	109,400	445,390
Early 1957 (est.)	318,300	27,290	114,200	459,790

. . . so is alkylation

	Cap., bbl. per stream day— Sulfuric	Hydrofluoric	Total
1-1-55	186,614	49,614	236,228
1-1-56	197,869	65,540	263,409
1-1-57 (est.)	212,069	66,040	278,109
Early 1957 (est.)	218,369	75,590	293,959

per cent of all thermal operations. Gas oil cracking and thermal reforming represent 42 per cent and 15 per cent of total capacity respectively.

The estimate of thermal cracking capacity for the first of 1957 is undoubtedly too high, since many cracking units will be shut down during the year. Reforming may be retained longer than formerly, due to its use in processing low-octane catalytic reformate stocks.

A steadily declining demand for heavy residual fuel oil is predicted in spite of the relative good current market for this product. It is likely that coking will continue to be adopted throughout the country. The present coking picture shows a total capacity of 337,590 bbl. per day. Of this, 88 per cent is delayed coking units, 8 per cent is in batch type stills and the remaining 4 per cent represents new fluid coking uits. This latter process will account for most of the projected increase over the next year and will represent 25 per cent of all coking capacity by early 1957.

Independents holding own . . . Much has been said of the plight of the independent refiner in these days of narrow profit margins and high octane levels. The current survey shows that the smaller refiner not only is holding his own in adding modern processing. But also he is actually increasing his percentage share of the total capacity in this country.

An arbitrary division of the industry at the 100,000 bbl. per stream day capacity shows that the larger companies, of course, control the bulk of refining capacity. A total of 20 companies in this country control about 100,000 bbl. of capacity each through their own and affiliated refineries. During the past 2 years their share of the nation's capacity has been rising slightly. The increase in this major class last year was due mainly to an additional company, D-X Sunray Oil Co., joining the 100,000 ranks through merger.

The 20 major oil refiners in the 100,000 bbl. ranks are:

1. Standard Oil Co. (N. J.).
2. Standard Oil Co. (Ind.).
3. Socony Mobil Co., Inc.
4. The Texas Co.
5. Gulf Oil Corp.
6. Shell Oil Co.
7. Standard Oil Co. of California.
8. Sinclair Refining Co.
9. Cities Service Co.
10. Sun Oil Co.
11. Phillips Petroleum Co.
12. Atlantic Refining Co.
13. Union Oil Co. of California.
14. Pure Oil Co.
15. Standard Oil Co. (Ohio).
16. Continental Oil Co.

17. Richfield Oil Corp.
18. Ashland Oil & Refining Co.
19. Tide Water Associated Oil Co.
20. D-X Sunray Oil Co.

This group broken down reveals only one company with eight plants has more than 1,000,000 bbl. of capacity representing 11.2 per cent of the U. S. total.

Six companies with 59 plants are in the 500,000-999,999-bbl. class. They hold 3,709,855 bbl. of capacity and 41.4 per cent of U. S. total. Six other companies with 28 plants have 1,639,340 total capacity and seven with 25 plants represent 958,700 of capacity. As a whole this group controls 81.6 per cent of total U. S. capacity.

In the smaller refinery group, six firms with 14 plants are in the 50,000-99,999-bbl. class totaling 321,150 bbl. and 3.6 per cent of U. S. capacity. Fifteen firms with 23 plants are in the 25,000-49,999-bbl. class. They hold 479,000 bbl. of capacity for 5.4 per cent of U. S. total.

The big group—less than 25,000-bbl.—contains 135 firms with 151 plants holding total capacity of 846,130 bbl. for 9.4 per cent of U. S. capacity.

Projected construction this year indicates that the smaller companies will increase their share of total crude capacity a slight amount. This smaller group includes many vigorous companies which are launching major expansion and modernization programs. In addition, a number of independents are planning new refineries on the East Coast, the South and the Pacific Northwest. Some of these projects are not definite, and have not been included in future projections.

In judging the independent refiners' ability to compete on product quality, the record shows that as a class they are neck and neck with the majors. On the average they remain slightly behind in catalytic cracking, although they improved their position measurably last year. Having led the majors in adopting catalytic reforming, they now show about the same relative position in that category. Lagging in alkylation and hydrogen treating facilities, they still lead the majors in polymerization.

On the basis of these figures alone, it is not valid to assume that independent refiners are uniformly in a competitive position today. Many small plants still exist without catalytic operations, and each year this number dwindles.

It should be noted that the small-refinery group includes 71 companies operating a total of over 135,000 bbl. per day in crude units, none of which has any catalytic capacity. A number of these companies make asphalt and other specialty products, and some enjoy an advantage in their immediate areas. But on the whole they are not competitive with the rest of the industry. Many will have to expand and modernize or they will not survive.

Removing this smallest group from the independent refiner class gives a truer picture of the competitive small refiner. Those 85 companies operating 117 plants maintain on the average 44 per cent of catalytic capacity on crude and 11.1 per cent of catalytic reforming on the same basis. On both counts they better the majors in catalytic facilities.

This vigorous contingent of smaller refiners is showing every sign not only of surviving but also of growing with national demand for liquid fuels. Current operations and building programs indicate the balance between the majors and the independents is changing very little. The edge is slightly in favor of the independent this year.

Canadian Refiners Moving Fast

CANADA has the fastest growing economy of any major country today. And this is putting the pressure on Candian refiners to meet the demands for liquid fuel and lubricants. At the same time the refiners are forced to compete briskly in the octane race.

The result has been an expansion in nearly every phase. This is the picture:

. . . Crude capacity was boosted 13 per cent last year and will go up another 9.3 per cent this year.

. . . Catalytic cracking capacity went up 50 per cent and is still expanding, although at a slower pace this year.

. . . Catalytic reforming is less advanced. But at the first of the year the industry maintained about 7 per cent of cat reforming capacity on the basis of crude. Total capacity, however, will be doubled within the next year or two.

. . . Hydrogen treating is in its early stages. A number of facilities has been in operation, but the bulk remains to be built this year or next.

Octanes . . . At the first of the year, premium gasoline marketed in Canada averaged 93.2 research octane number and regular 86.6.

These levels remain lower than the averages below the border, but an octane race is believed shaping up in Canada. Competition within the industry will bring it on.

A number of new and modernized refineries across the nation are now in a position to produce octanes competitive with any in the U. S. These new facilities are shared by major oil companies and independents alike.

The percentage of small, uneconomic refineries in Canada is much lower than in the U. S. This is due in large part to the vigorous growth which the oil industry has undergone in the past several years. Indications are strong that Canada will continue to maintain its self-sufficiency in refining capacity, and will bolster its position on crude as well.

Plants dispersed . . . New capacity added last year and under way during 1956 is well distributed throughout the country.

The Pacific Coast plants have been completely expanded and modernized and the major centers in Montreal and Sarnia have seen continuous construction activity. Additional refineries are said to be in the planning stages for Ontario and British Columbia.

At least one European company is surveying Canadian markets with the possible view to building a refinery, probably in Quebec or Ontario.

Canadian Refining Capacity

(Barrels per stream day)

	1-1-54	1-1-55	1-1-56	Est. 1-1-57
Crude	570,560	608,740	680,645	744,270
Per cent annual increase	12.8	6.8	11.8	9.5
Thermal cracking	170,804	172,134	167,970	183,695
Per cent of crude	29.9	28.3	24.7	24.7
Catalytic cracking	168,108	211,550	324,550	341,250
Per cent of crude	29.4	34.7	47.6	45.8
Catalytic reforming	8,930	12,030	48,800	79,875
Per cent of crude	1.6	2.0	7.2	10.7
Polymerization	11,894	19,424	17,805	17,905
Per cent of crude	2.1	3.2	2.6	2.4
Hydrogen treating		666	7,397	26,272
Per cent of crude			1.1	3.5

Big Gas Line Planned

Northern Natural proposes to protect market by bringing Alberta surplus gas to U. S. midwest in new 1,215-mile line

CALGARY.—Northern Natural Gas Co. of Omaha is proposing a 1,215-mile, big-inch pipeline from western Alberta to Minneapolis to import 300 million cubic feet daily of surplus Canadian gas into the northern plains market.

Northern Natural revealed its proposed project last week when it applied to the Alberta Petroleum and Natural Gas Conservation Board for permission to export the gas from Canada.

The company declared the Alberta gas would bolster its supplies and reserves for serving its markets in the U. S. Midwest and other pipeline companies serving the Great Lakes areas.

Source of the gas would be the Savanna Creek, Pincher Creek, and other southern Alberta gas-producing areas.

What's involved . . . Northern Natural plans two pipeline projects to transport the gas into the United States. They are:

. . . A 73-mile, 20-in. line from Savanna Creek to the Pincher Creek fields and 32 miles of 24-in. line from there to the Montana border. Estimated cost of this project is $8 million.

. . . A 1,100-mile, 26-in. line from the Montana border to Minneapolis. The gas would be picked up at the border by Northern Plains Natural Gas Co., a wholly owned subsidiary, which also would build the line to Minneapolis. This line would pass through northern Montana and North Dakota to Grand Forks where it would turn southeast to Minneapolis.

Supplies . . . The Northern Natural application seeks a 25-year permit from the fall of 1957. The maximum daily volume sought is 300 million cubic feet with estimated withdrawal of 90 billion cubic feet.

Northern Natural explained it expects to have 100 million cubic feet daily of its own natural gas developed in Savanna Creek by 1957. The other 200 million cubic feet daily will be furnished by contract from other Alberta producers. Northern Natural also has considerable acreage leased for natural-gas exploration in both Montana and North Dakota within easy gathering distance of the proposed line.

Northern Natural said the present gas reserve estimates in Pincher Creek indicate substantial volumes of gas may be available in excess of that made available to Trans-Canada Pipe Lines, Ltd.

The Omaha company reported its move to import Canadian gas was promoted by a desire to bolster the firm's long-range reserve position in the face of expanding markets. Northern Natural's present main-line system extends from the Texas Panhandle through Omaha to Minneapolis. It has connections in the Panhandle with El Paso Natural Gas Co.

Thus its present supplies come from gas fields in the Permian basin of West Texas, and the Hugoton fields of Texas, Oklahoma, and Kansas. Proved reserves controlled by the company total 9.25 trillion cubic feet of which 104 billion cubic feet are in Montana and Alberta.

Battle of lines . . . Northern Natural's proposal is seen in some quarters as another move to counter plans of Tennessee Gas Transmission Co., through its affiliate, Midwestern Gas Transmission Co., to cut through the Midwest marketing area with a line from Canada.

Midwestern's application for permit to drop a line south from Emerson, Man., through Minneapolis to Chicago area is being heard currently by the Federal Power Commission.

Chicago natural-gas interests, headed by Peoples Gas, Light & Coke Co., earlier launched a move to bring gas from the American Rockies into the Great Lakes area to forestall Midwestern's project *(The Oil and Gas Journal, February 20, page 93)*.

Officials of Northern Natural declined to comment on the competitive aspects of the proposed pipeline. In its application, however, the company declared that Peoples Gas and Michigan-Wisconsin Pipeline Co. have expressed interest in buying substantial volumes of Canadian gas from the proposed line. Michigan-Wisconsin has extensive pipelines and retail properties in Michigan and Wisconsin. Peoples distributes in the Chicago area.

Last week in Washington, Michigan-Wisconsin Pipe Line Co. of Detroit applied for an FPC permit to build 424 miles of pipeline extensions, 48 miles of main-line loops, and 12,600-hp. compressor capacity in Wisconsin, Illinois, and Michigan. The project will initiate natural-gas service to 10 companies serving 41 communities in Wisconsin and Michigan.

Northern Natural pointed out also that an exchange of gas might be arranged so that the $11 million gathering line to be built by Alberta Gas Trunkline could be eliminated initially or permanently without depriving Pincher Creek gas of a market. Alberta Trunkline is the proposed gathering system for the Trans-Canada line.

Northern Natural also pointed out that its proposed line would be only 80 miles from the border. It would permit ready connection to purchase gas from Trans-Canada or in the interim permit the reverse flow northward of natural gas to Winnipeg.

Socony Expansion Under Way

NEW YORK.—Socony Mobil Oil Co., Inc., aiming at ever-higher octanes, is well along on an ambitious expansion program.

Four T.C.R. and Sovaforming catalytic reformers already are on stream at refineries of Socony, General Petroleum Corp., and Magnolia Petroleum Co. The integrated company plans to add 10 more in this country between

now and 1958. These will boost total cat reforming capacity to 150,000 bbl. daily—or about 25 per cent of basic crude capacity.

Alkylation capacity is due to be boosted, too. The five units now operating will be expanded from their present capacity of about 17,000 bbl. daily, and four new alky plants will be built. Also, Socony will build several hydrogen-treating units at U. S. refineries to use reformer tail gas for upgrading feed stocks and products.

Domestic crude capacity is due to be expanded from the present 680,000 to 760,000 bbl. daily by 1958.

Gas Supply Signed

Contracts almost complete Trans-Canada requirements

CALGARY. — Trans-Canada Pipe Lines, Ltd., has lined up the major portion of its gas supply for the proposed 2,250-mile line from Alberta to Quebec.

The assured supply will lend weight to its export plan now before the Federal Power Commission. The export plan must be approved to open the U. S. market which will make Trans-Canada economically feasible.

Trans-Canada signed two important contracts last week. The pipeline will buy 100,000,000 cu. ft. of natural gas daily from California Standard Co. and 25,000,000 cu. ft. daily from Home Oil Co., Ltd. Reserves dedicated to the project are located in Nevis, Atlee-Buffalo, Princess, Homeglen-Rimbey, and Gilbey fields in Alberta.

Trans-Canada announced the major portion of its gas requirements had been filled. Eighty per cent of the suppliers were already reported in the fold. The first big producer to break the ice was Canadian Gulf Oil Co. It agreed to sell 100,000,000 cu. ft. daily initially and 170,000,000 cu. ft. daily beginning the second year of a 25-year contract *(The Oil and Gas Journal, October 31, 1955, page 66)*. Another 135,000,000 cu. ft. daily was contracted from other producers.

The pipeline has an Alberta permit to transport an average of 500,000,000 cu. ft. daily eastward to U. S. and Canadian markets. The peak on any day may not exceed 620,000,000 cu. ft.

One of the big problems facing Trans-Canada has been financing an uneconomical section of the line across northern Ontario. Last week, this problem was eased when the Ontario Government gave third and final reading to a bill approving provincial participation in the financing.

Only the signature of the lieutenant governor—a formality—is now required for the bill to become law.

watching WASHINGTON

. . . with Bertram F. Linz

FPC, Interior Department Changes Due

A COUPLE of important government job changes will take place in Washington within the next 3 months.

Douglas McKay will resign as Secretary of the Interior in May to run for the Senate against Sen. Wayne Morse of Oregon. Morse, twice elected as a Republican, deserted the party to become first an independent and later a Democrat. He is probably the one man the Republican Party would most like to see on a desert island.

The second change will be in the Federal Power Commission. Claude L. Draper, whose term will expire June 22, has advised the President he wants to retire. Originally appointed by President Hoover in December 1930, he was reappointed by both Roosevelt and Truman. He was the only member of the FPC to oppose the Harris bill.

McKay's resignation will be the third change in Eisenhower's cabinet.

Several westerners are being mentioned to succeed McKay. Most prominent in the speculation over his successor is former Gov. Dan Thornton of Colorado.

Old Problem, Old Cure, Same Cold Shoulder

AN old panacea for the farm problem has bobbed up again. It's the idea of making alcohol from surplus agricultural products and using it in motor fuel.

Sen. Carl T. Curtis of Nebraska and Rep. Ben F. Jensen of Iowa are backing the latest effort to make the farmer part of the gasoline business.

They point out that alcohol has been used as a motor fuel in some foreign countries. They propose a 5 per cent blend with gasoline and offer the attractive two-way argument that this would use up over a billion bushels of grain each year and conserve petroleum resources which are being depleted.

It is figured that a 5 per cent blend would require 2,775,000,000 gal. of alcohol and save a corresponding volume of gasoline.

The alcohol-gasoline plan has cropped up in Congress periodically, almost every time farm relief legislation is undertaken. But Congress has always been cool to the idea of debasing gasoline, and there's no indication it has warmed up this year.

Senators Hit for Gas-Bill Vote

NORTHERN Republican senators who put their political future on the line to vote for the Harris-Fulbright gas bill are already feeling the heat from back home.

With primaries coming up soon in many states, rival candidates are bearing down heavily on the gas issue, according to reports from Wisconsin and other areas. They charge that a vote for the bill was a betrayal of the consumer.

But it is also charged that Republicans supporting the bill fell into a Democratic trap. That, of course, is not true. While Republican and Democratic leaders joined in pressing the bill, the latter were from the gas-producing states and faced little criticism from voters who were more familiar with the issue than those in the North and East.

Republicans who voted for the bill did so on its merits, believing President Eisenhower would support them. That he did not is another story. But one fact didn't get much play in press reports on the bill. It was the Republican votes that put it through the Senate. More Republicans than Democrats voted for it, 31 against 22 to be exact. More Democrats than Republicans voted against it—24 to 14.

A number of northern Republicans, therefore, are facing two fights in which their stand on the gas bill may be a big issue, first in the primaries and in November in the congressional elections.

New Division of Allowables Suggested

AUSTIN.—Humble Oil & Refining Co. has informed the Texas Railroad Commission that roughly 8 per cent more oil-production allowable could be given the majority of Texas fields if the "privileged status" of fields now exempt from shutdown days were revoked.

Humble took this position with a formal statement and enlarged upon it while recommending that the exempt status of South Boling and Cedar Point fields on the Gulf Coast be canceled. South Boling and Cedar Point were two of three exempt fields examined by the commission March 7 during its inquiry into the status of all exempt fields in District 3 on the Gulf Coast.

Similar hearings are expected to be held on exempt fields in other districts after all District 3 fields are examined.

Texas fields are exempt if they produce under secondary water floods, if they are heavy water or sand producers, or if they are marginal operations for other reasons.

Humble's chief petroleum engineer, Douglas Ragland, filed the company statement following a request by Examiner Mac Coker. Coker asked the company for an estimate of the additional allowable which would be available for distribution to the more than 3,700 nonexempt fields in Texas if shutdown days were applied to all 417 exempt fields.

Texas had an exempt allowable as of January 14 of 982,657 bbl. daily, Humble told the commission. This is an increase of 472,000 bbl. since exemptions were reinstated in January 1949. The figure is increasing annually.

The company estimates that about 43 per cent of the total, or 424,000 bbl. daily, could be removed from exempt status without causing waste. Then an additional 174,000 bbl. daily could be distributed to fields subject to shutdown days, Humble argues.

How it figures . . . Humble split the total exempt allowable into three categories, amounting to:

. . . 159,516 bbl. daily of production from wells producing below the statutory marginal rates in fields subject to shutdown days.

. . . 139,074 bbl. daily of discovery-allowable exemption.

. . . 684,067 bbl. daily in other totally exempt fields.

The first two groups are untouchable. Humble estimates, however, that 62 per cent or 424,000 bbl. daily of the exempt production in the third category is assigned to wells with allowables above the statutory marginal rates.

The Railroad Commission, Humble maintains, is required to prevent waste of oil and gas and also to prevent unreasonable discrimination between fields.

"In keeping with these requirements, the privileged status of these exempt fields should be continued only in those instances where the commission has made a finding supported by sound technical evidence adduced at a hearing that such exemptions are necessary to prevent waste or to prevent unreasonable discrimination.

"Advancements in producing techniques during recent years are such that there are very few cases for which exemptions can be justified on the basis of waste prevention. It is evident that a large majority of the royalty owners and the operators in Texas are required to reduce their production so that exempt fields can produce more than their fair share of the market demand.

Water floods included . . . It is Humble's third or 684,067 bbl. daily category which takes in production from fields producing under secondary water floods.

The commission in the past has permitted such floods—launched when primary production was depleted or near depletion—to produce all the oil they can and with no shutdown-day restrictions.

It's reasoning was that operators should be encouraged in this manner to start water floods, otherwise wells in many floodable fields might be plugged and much oil lost or wasted. The reasoning also was based, at least partially, on a premise held generally that water-flood production might be injured if not produced continuously and at high rates.

Humble argues that research it has conducted in the lab has shown this latter belief to be false. It contends that water-injection and oil-production rates of floods can be controlled without waste or injury to the flood mechanism and that lower production rates will eventually net the most oil. *(The Oil and Gas Journal, December 19, 1955, page 50, and February 20, 1956, page 94).*

The company contends, thus, that floods should not be exempt from shutdown days and that no water-flood producing well should be permitted to produce over MER.

There are virtually no water floods operating in District 3 where exempt hearings are now going on. Such hearings when extended to other districts where there are many floods are expected to produce considerable fireworks.

Opposition planned . . A substantial group of water-flood operators in the state has been gathering ammunition for use when needed to block the Humble drive so far as it concerns secondary water floods.

The opposition includes the West Central Texas Oil and Gas Association, the West Central Texas Water Flood Association, the Permian Basin Water Flood Association, and a large group of oil companies—mostly independents but including several majors.

Spokesmen for this side say that by far the bulk of technical findings hold that high and continuous rates of water injection and oil production are necessary for maximum ultimate recovery in a water flood.

They argue further that most water floods are fairly small projects carried out by independents. Such operators are in no position financially, they say, to invest large sums in a water flood and then wait years to get their money back much less to make a profit.

They contend that adoption of the Humble recommendations would mean that a great number of likely projects never would be started and thus a great quantity of recoverable oil lost.

Painting Costs Cut

Indiana Standard control project saves 35 per cent

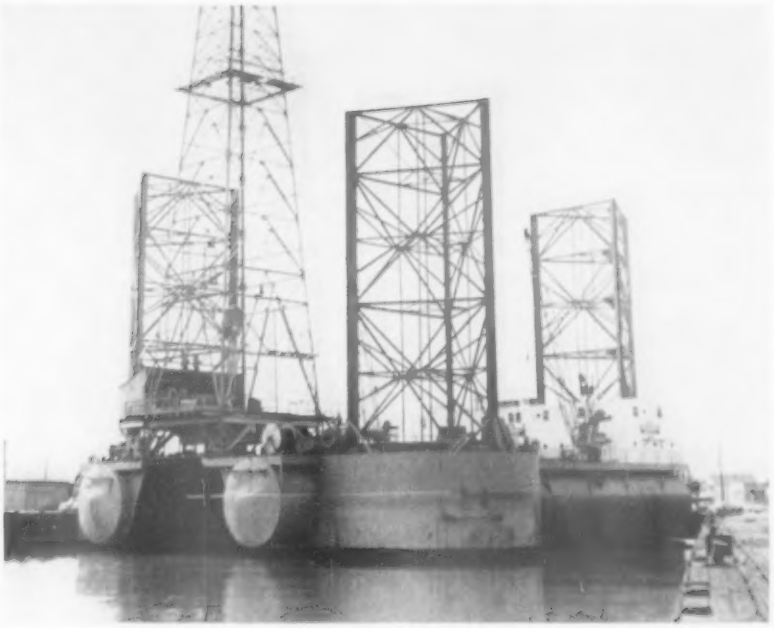
NEW YORK.—Painting costs in a refinery can be cut considerably if a company makes an organized effort. Such an effort by Standard Oil Co. (Ind.) brought a 35 per cent slash and a saving of $48,000 per year.

The firm's program had many facets, three Indiana Standard authors told the National Society of Corrosion Engineers here last week.

Surface preparation and mil thickness were stressed. Paint quality was carefully tested and special primer formulations were tailored by paint companies. Paint thinning was strictly controlled.

Careful records on individual tanks helped to check results on new practices and show where repainting would profit most. Rollers were substituted for brushes wherever possible to cut labor costs, which run 75 per cent of painting budgets.

Under the new program only 5.5 per cent of tanks now need repainting oftener than every 36 months, compared with 40 per cent in 1949 and 1950.



Three-Legged Platform Ready for Work

GALVESTON.—The first three-legged mobile drilling platform for offshore oil operations will be christened March 20 and will leave a few days later for its first drilling assignment off the Texas coast.

Designed and built by R. G. LeTourneau, Inc., the unit will be owned and operated by Zapata Off-Shore Co., tidelands drilling contractors.

The "Scorpion," as the unit is called, was built at LeTourneau's Vicksburg, Miss., yard and floated down the Mississippi River and across the Gulf of Mexico to Galveston for outfitting.

Fully equipped, the "Scorpion" represents an investment of about $3,000,000. The drilling rig was furnished by Oil Well Supply Division of U. S. Steel Corp. Much of the equipment was engineered especially for the offshore unit.

All drilling operations can be controlled from the driller's derrick-floor console, although most of the drilling equipment is below deck where it will be protected from salt spray. An Oilwell 96 draw works with 60-in. Parkersburg hydromatic brake and Oilwell 15 drilling control are immediately below the driller's position. These are driven of a chain compound from four General Motors 6-110 diesel engines. The compound also powers two 818P Oilwell mud pumps.

The unit's first assignment will be for Standard Oil Co. of Texas in water 46 ft. deep off Port Aransas, Tex. It will be towed to location about March 24.

Texas Starts Move to Keep Gas at Home

AUSTIN.—Mounting moves to keep uncommitted natural-gas reserves at home is becoming a political and economic issue in Texas.

This became more apparent last week with these developments:

... **Texas Gas Corp.** completed a pipeline outlet from Marrs McLean field near Beaumont to increase its gas supply for local markets. The firm announced it would start a campaign to attract new industries to the Port Arthur-Orange-Beaumont area.

... **Sen. Price Daniel** said he is "ready and willing" to run for governor on a platform of greater industrialization of the state based on use of Texas' gas.

Texas Gas reported deliveries are scheduled to start immediately over its 10-in. line. The artery links Marrs McLean field with the company's system at Fannett, Tex., 10 miles away. The line will increase Texas Gas' supply for local markets by 30 to 40 million cubic feet per day.

Texas Gas and its subsidiary, Texas Gas Pipe Line Corp., sell gas for both interstate and intrastate consumption. Planned construction will expand their deliverability from 271 million cubic feet to 300 million cubic feet daily.

Russell M. Riggins, Texas Gas president, said failure to get legislation easing federal controls on gas produced for interstate commerce has caused a growing demand for gas to be used by local industries. He said his firm plans a campaign to attract new gas-consuming industries and added throughput of the new line "will be for sale intrastate."

Daniel told a Texas radio and television audience "we must continue to fight for freedom of our natural resources from federal control. But until that fight is won, we should bring many new industries to our own natural resources within the state where they are free from federal controls."

Daniel reported he will have a decision on making the gubernatorial race by March 26. The delay, he explained, was to analyze results of his appeal for expressions of support.

Crude Line Planned

Sundre-Westward Ho oil to move southeast to Calgary

CALGARY.—Cremona Pipe Lines, Ltd., has received a permit to build a 60-mile crude pipeline from the Sundre-Westward Ho region to the Calgary refining area.

The 8-in. line, designed for initial capacity of 18,000 bbl. daily, will provide an outlet for an estimated 96,000 bbl. of crude-oil reserves.

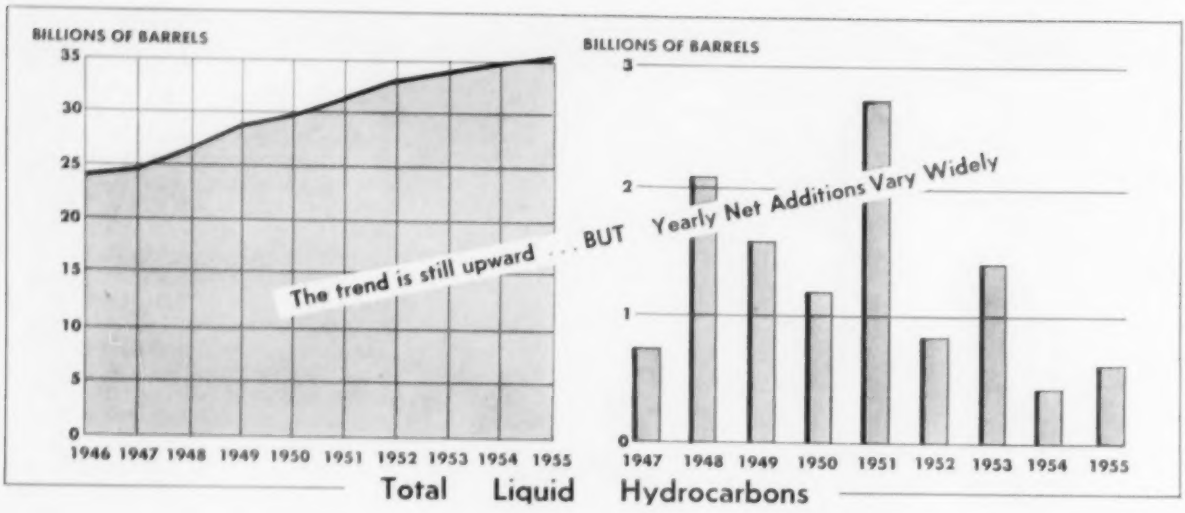
Cremona, a subsidiary of Home Oil Co., Ltd., won out over two competitors before the Alberta Petroleum and Natural Gas Conservation Board.

Pembina Pipe Lines, Ltd., backed by Mannix, Ltd., proposed to extend its present line from Pembina field to the Sundre-Westward Ho area and move the crude north to Edmonton.

Rangeland Pipeline Co., Ltd., a subsidiary of Hudson's Bay Oil & Gas Co., also proposed to move the crude to Edmonton. It planned a line into the Rimby area to hook up with a proposed extension of Texaco Exploration Co.'s system.

Cremona will build a 6-in. line from Sundre field to the main trunk line. Cost of the entire project is estimated to be $2,750,000. Pipe has already been ordered. Crews will start immediately to survey the route and purchase right-of-way.

The producing area northwest of here is 65 miles long and 20 miles wide. Principal developers include Hudson's Bay, Home Oil, Federated Petroleums, Ltd., Alminex, Ltd., Calgary & Edmonton Corp., and Trans-Border Oils.



Gas Reserves Soar; Crude Rises Some

THE year just past was a sorry one for oil and an extraordinary one for gas—from the viewpoint of new reserves.

This is indicated in the joint annual report on reserves of the American Petroleum Institute and the American Gas Association.

The A.P.I. committee concluded that a net of 451.4 million barrels of crude was added to the nation's reserves in 1955—the lowest net addition since 1945.

The A.G.A. committee figured net additions to gas reserves at almost 12 trillion cubic feet—the largest net addition since 1946.

The reports concluded that a net of 194.1 million barrels of gas liquids was added to reserves—a figure almost equal to the amount lost during 1954.

These additions sent all reserves figures to record highs: crude to more than 30 billion barrels for the first time, gas liquids to 5.4 billion barrels, and natural gas to 223.7 trillion cubic feet.

New highs in reserves were reached in spite of record production in all three petroleum divisions. Crude production last year hit a peak of 2.4 billion barrels, gas liquids output totaled 320.4 million barrels, and gas production totaled 10.1 trillion cubic feet.

Natural gas . . . It was the best year for natural-gas reserves in recent history, according to the committee's figures.

The report indicated that more than twice as much gas was found last year (by discoveries, extensions, or revised estimates) as in 1954, and with less drilling.

The committee figured a net addition to reserves of nearly 12 trillion cubic feet, compared with only 263 billion in 1954 (small chart). The contrast, however, isn't so great as it might seem. New supply (discoveries plus extensions and revisions) in 1955 was 22 trillion feet, compared with 9.6 trillion in '54, an actual increase of 129 per cent.

Production in '54, however, came close to equalling the new supply credited to the year, causing a great contrast in net additions to reserves.

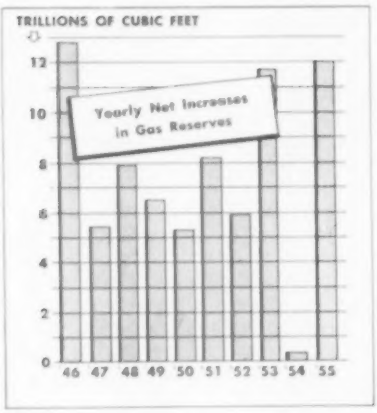
A puzzling aspect of the report was the fact that there seemed to be little

Proved Reserves of Liquid Hydrocarbons

(Thousands of barrels)

	Proved reserves as of 1-1-55	Extensions and revisions	New discoveries*	Prod. during 1954	Proved reserves as of 1-1-56	Changes in reserves during 1955
Alabama‡	15,565	159	6,300	1,420	20,604	5,039
Arkansas	398,339	2,090	2,748	28,514	374,663	—23,676
California†	4,218,837	262,177	30,987	385,652	4,126,349	—92,488
Colorado	341,398	39,216	19,468	53,568	346,514	5,116
Illinois	680,631	109,294	4,576	84,883	709,618	28,987
Indiana	67,334	4,654	367	10,765	61,590	— 5,744
Kansas	1,153,646	124,276	18,887	125,505	1,171,304	17,658
Kentucky	96,081	34,689	3,476	18,117	116,129	20,048
Louisiana†	3,845,697	447,446	182,079	283,985	4,191,237	345,540
Michigan	60,533	10,139	425	11,336	59,761	— 772
Mississippi	472,696	306	11,652	39,076	445,578	—27,118
Montana	279,573	36,525	5,460	15,753	305,805	26,232
Nebraska	40,299	21,056	14,973	12,195	64,133	23,834
New Mexico	1,145,877	102,280	9,864	96,156	1,161,865	15,988
New York‡	45,831			2,888	42,943	— 2,888
North Dakota‡	134,349	58,040	4,300	11,157	185,532	51,183
Ohio	38,211	23,746	14	4,414	57,557	19,346
Oklahoma	2,289,259	284,182	27,122	230,164	2,370,399	81,140
Pennsylvania	104,718	188	94	8,632	96,368	— 8,350
Texas†	17,910,140	1,078,352	192,842	1,202,471	17,978,863	68,723
Utah	36,461	2,552	373	2,166	37,220	759
West Virginia	71,306	12,743	218	6,741	77,526	6,220
Wyoming	1,354,263	164,564	7,808	102,657	1,423,978	69,715
Miscellaneous§	4,159	22,253	272	1,485	25,199	21,040
Total U. S.	34,805,203	2,840,927	544,305	2,739,700	35,450,735	645,532

*Only a limited area is assigned to each new discovery. The concern is only with actually proved reserves. †Includes offshore reserves. ‡Crude oil only. §Includes Alabama and North Dakota natural-gas liquids; Arizona, Missouri, Nevada, South Dakota, Tennessee, and Virginia crude; and Florida crude and natural-gas liquids.



relation between the amount of reserves added and the amount of drilling done.

Wildcat gas completions last year were down 11.5 per cent from '54 and total gas completions dropped 9.2 per cent. But the report showed an increase of 15.1 per cent for new gas discoveries and a jump of 25.18 per cent for extensions and revisions.

Total completions last year were 3,613 compared with 3,977 in '54, and successful gas wildcats were 353, compared with 399.

Another interesting note was the fact that, on an energy-content basis, gas reserves added in 1955 were greater than reserves of all liquid hydrocarbons. The total for crude oil and gas liquids was 3.4 billion barrels, while the oil equivalent of new gas reserves was about 3.6 billion barrels.

Louisiana was credited with providing the biggest portion of the 11,986,713 million cubic feet of net reserves added in the nation last year. The committee credited a total of 5.6 trillion to Louisiana. Of this total, 4.4 trillion is nonassociated gas; 9 trillion is associated gas, and 0.3 trillion is dissolved gas.

The other big increases were 3.2 trillion in Texas and 1.4 trillion in New Mexico.

Crude oil . . . The bulk of the new supply was, as usual, provided through "extensions and revisions" rather than new discoveries.

The committee credited about 477 million barrels to wildcat discoveries and 2.4 billion to "extensions and revisions." These represent reserves proved by extensions to existing fields and those added through revision of previous estimates.

As in the case of natural gas, Louisiana was credited with the biggest net increase in crude reserves—293.6 million barrels. Wyoming was second and Oklahoma third.

Eight states showed net losses in

Proved Reserves of Crude Oil

(Thousands of barrels)

	Proved reserves as of 1-1-55	Extensions and revisions	New discoveries*	Prod. during 1955	Proved reserves as of 1-1-56	Changes in reserves during 1955
Alabama	15,565	159	6,300	1,420	20,604	5,039
Arkansas	351,420	1,783	2,741	26,405	329,539	—21,881
California†	3,888,588	237,964	29,668	354,812	3,801,408	—87,180
Colorado	328,651	38,770	19,418	52,836	334,003	5,352
Illinois	658,411	110,710	4,395	82,355	691,161	32,750
Indiana	67,183	4,651	367	10,743	61,458	— 5,725
Kansas	978,449	123,356	16,737	120,474	998,068	19,619
Kentucky	85,341	34,422	3,343	15,652	107,454	22,113
Louisiana†	2,961,651	381,606	157,125	245,095	3,255,287	293,636
Michigan	59,620	10,123	400	11,254	58,889	— 731
Mississippi	412,276	23	11,236	35,833	387,702	—24,574
Montana	272,394	36,558	5,460	15,464	298,948	26,554
Nebraska	38,031	16,540	14,972	11,846	57,697	19,666
New Mexico	805,886	86,016	8,576	80,820	819,658	13,772
New York	45,831			2,888	42,943	— 2,888
North Dakota	134,349	58,040	4,300	11,157	185,532	51,183
Ohio	36,772	23,615		4,387	56,000	19,228
Oklahoma	1,995,348	240,932	20,564	200,799	2,016,045	60,697
Pennsylvania	101,849			8,505	93,344	— 8,505
Texas†	14,982,003	809,657	164,181	1,022,339	14,933,502	—48,501
Utah	36,414	2,503	356	2,161	37,112	698
West Virginia	37,312	12,088		2,400	47,000	9,688
Wyoming	1,303,577	162,475	6,548	98,970	1,373,630	70,053
Miscellaneous‡	3,825	1,776	270	685	5,186	1,361
Total U. S.	29,560,746	2,393,767	476,957	2,419,300	30,012,170	451,424

*Only a limited area is assigned to each new discovery. The concern is only with actually proved reserves. †Includes offshore reserves. ‡Includes Arizona, Florida, Missouri, Nevada, South Dakota, Tennessee, and Virginia.

Proved Natural-Gas Recoverable Reserves

(Millions of cubic feet—14.65 psia. at 60° F.)

	Reserves as of 1-1-55*	Changes in reserves during 1955: Extensions and revisions*	Discoveries*	Net change in underground storage†	Net prod.‡	Reserves as of 1-1-56*
Arkansas	1,165,379	7,763	30,861	—1,755	37,881	1,164,367
California§	9,026,603	305,096	72,564	2,165	513,478	8,892,950
Colorado	1,932,913	317,290	72,666	0	69,307	2,253,562
Illinois	253,756	5,306	2,120	662	28,279	233,565
Indiana	36,049	264	0	1,280	4,482	33,111
Kansas	15,758,332	834,214	214,995	1,629	516,090	16,293,080
Kentucky	1,286,607	41,404	8,480	—1,221	73,000	1,262,270
Louisiana§	36,799,986	4,875,622	2,450,107	0	1,690,123	42,435,592
Michigan	330,000	8,464	5,000	—7,106	10,584	325,874
Mississippi	2,772,683	25,340	20,945	130	210,758	2,608,340
Montana	723,731	11,401	17,048	57	32,518	719,719
Nebraska	192,946	24,802	5,200	0	19,527	203,421
New Mexico	17,240,669	1,620,564	254,287	13,567	544,175	18,584,912
New York	69,362	—2,514	1,000	11,064	3,152	75,760
North Dakota	164,025	130,188	3,077	0	16,594	280,696
Ohio	774,741	46,601	7,952	15,661	35,081	809,874
Oklahoma	12,396,148	1,388,178	293,842	5,269	878,698	13,204,739
Pennsylvania	732,163	43,529	67,048	35,253	123,604	754,389
Texas§	105,129,062	6,164,388	1,974,608	1,511	4,982,021	108,287,548
Utah	387,375	1,912	49,870	0	18,261	420,896
West Virginia	1,607,290	91,634	39,725	9,989	183,739	1,564,899
Wyoming	2,855,071	351,472	112,546	—1,438	121,548	3,196,103
Miscellaneous¶	75,741	5,207	15,128	920	5,218	91,778
Total	211,710,732	16,298,125	5,719,069	87,637	10,118,118	223,697,445

*Excludes gas loss due to natural-gas liquids recovery. †The net difference between gas stored in and gas withdrawn from underground storage reservoirs, inclusive of adjustments and native gas transferred from other reserve categories. ‡Net production equals gross withdrawals less gas injected into producing reservoirs. Changes in underground storage and gas loss due to natural-gas liquids recovery are excluded. Fourth quarter production estimated in some instances. §Includes offshore reserves. ¶Includes Alabama, Arizona, Florida, Iowa, Maryland, Missouri, Nevada, and Virginia.

reserves during the year, with California leading this group with a drop of 87.2 million barrels. Texas was close behind, being credited with a loss of 48.5 million barrels.

Reserves added through new discoveries were the lowest since 1951, the report showed. But the figure for 1955 was higher than 1947 or 1948.

Gas liquids . . . New discoveries were credited with adding 67.3 million barrels and extensions and revisions were given 447.2 million in the report.

Production during the year was set at 320.4 million barrels, leaving a net addition to reserves for the year of 194.1 million.

Adding gas liquids to crude oil, the committees came up with a total reserves figure of 35.45 billion barrels for all liquid hydrocarbons, an increase of 645.5 million barrels.

Canada Shows Gain

Increase for crude is less than in '54, but still big

CANADIAN crude-oil reserves climbed 301,920,000 bbl. during 1955, according to the report of the Canadian Petroleum Association.

The increase lacked about 60 million barrels being as great as the gain in 1954. It was notable, however, because it was recorded during a year which saw production climb 33.4 per cent—from a total of 95.6 million barrels in 1954 to 127.5 million in 1955.

Crude reserves at the beginning of 1956 were set at 2.5 billion barrels.

Natural-gas liquids gained 38.8 million barrels during the year to a new high of 247.1 million. This gives Canada a present reserves figure for all liquid hydrocarbons of 2,756,619,000 bbl.

Corrosion Studied

Reformer damage is worse than was first expected

NEW YORK. — Octanes are costing refiners more ways than one. A new cost item which is appearing fast is the corrosion encountered in catalytic reformers and desulfurization units.

This type of hydrogen-sulfide corrosion was not initially anticipated. It differs from the corrosion experienced in crude and thermal-cracking units in occurring at lower levels of sulfur content and in attacking the chrome-moly steels which were believed resistant to hydrogen sulfide.

In view of the widespread application of both catalytic reforming and hydrogen treating, this new corrosion threat calls for a broad study.

A start on such a study was reported last week before the National Association of Corrosion Engineers by M. W. Kellogg Co. Extensive findings of laboratory and pilot-plant tests and refinery experience have been compiled, correlated, and reviewed by the two Kellogg authors, G. Sorell and W. B. Hoyt.

The best correlating variable appears to be the partial pressure of hydrogen sulfide, they conclude.

The sulfide scale offers only partial protection to corroded materials; and cyclic effects, varying temperature, and alternating oxidizing and reducing atmospheres contribute to the attack by removing the scale.

In reformer service the attack is not as serious and carbon and low alloy steels are adequate in some cases. But in desulfurizer units and in reformers, where feed desulfurization and recycle scrubbing are not practiced, stainless steels, notably the chrome nickel grades, give excellent resistance.

Canada's Proved Reserves

(Thousands of barrels)

	Proved reserves as of 1-1-55	Extensions and revisions	New fields and new pools*	Prod. during 1955	Proved reserves as of 1-1-56	Changes in reserves during 1955
Crude oil:						
Northwest Territories	26,172	27,939		404	53,707	27,535
Alberta and British Columbia	1,928,479	310,978	41,862	111,334	2,169,985	241,506
Saskatchewan	222,365	7,418	18,125	11,036	236,872	14,507
Manitoba	29,127	16,743	3,539	4,198	45,211	16,084
Ontario and New Brunswick	1,471	2,783	40	535	3,759	2,288
Total crude oil	2,207,614	365,861	63,566	127,507	2,509,534	301,920
Natural-gas liquids†	208,331	40,404	750	2,400	247,085	38,754
Total liquid hydrocarbons	2,415,945	406,265	64,316	129,907	2,756,619	340,674

*Only a limited area is assigned to each new discovery. Hence, figures in this column may be considered minimum figures. †All natural-gas liquids located in Alberta and British Columbia.

Industry BRIEFS

DENVER. — Colorado Oil & Gas Corp., Denver, is preparing for exploration of leases in Alaska. A company spokesman said application has been filed in the Anchorage land office for 16 oil and gas leases covering 35,200 acres. The applications were accompanied by checks totaling $8,960 for filing and lease fees.

LOS ANGELES.—Stockholders of the Republic Supply Co. of California approved the recently announced purchase of the entire equipment of Thomas P. Pike Drilling Co., Los Angeles. Sixteen drilling rigs acquired from Pike are up for sale.

SAN ANTONIO. — The newly organized South States Oil & Gas Co. has purchased the L. M. Lockhart leases in West Texas. Eighteen oil and gas wells are involved, with some 22 billion cubic feet of gas and 600,000 bbl. of crude-oil reserves. Sale price was $1,725,000. George M. Luhn, South States president, and Elmer A. Dittmar, investment banker, organized the company.

NEW YORK.—The American Zinc Institute, New York, has produced a 35-minute, 16-mm. color movie on the fundamentals of corrosion and its control. Entitled "Zinc Controls Corrosion," the film is available to oil companies and educational groups.

TULSA.—Sun Pipe Line Co. has let construction contracts for 109 miles of 14-in. products pipeline from Marcus Hook, Pa., to Newark, N. J. The line will parallel an existing 8-in. line which will be taken up. Sheehan Pipe Line Construction Co., Tulsa, will lay 90 miles of the line. Delaney - Missouri Valley Construction Corp., Freehold, N. J., will lay the remainder. Work will start about May 1.

NEW YORK.—Witco Chemical Co. sold all its oil and gas-producing properties. The properties included 25 oil and gas wells located in Moore, Hutchinson, and Carson counties of the Texas Panhandle and Rio Arriba County, New Mexico.

Fifteen wells went to Producing Properties, Inc., Dallas, for about $1,750,000. The 13 gas wells invloved produce a total of 10,000,000 cu. ft. daily. Witco sold the production because it did not fit into plans for continued growth in the chemical field. Proceeds will go into long-range chemical expansion.

100 octane to hit market? . . .

. . . All Eyes Are on Sun

SUN OIL CO. may be the first company to introduce 100-octane premium motor fuel at its service stations located in most states east of the Mississippi.

This speculation was circulating in refining and marketing circles during the past week.

Sun has become one of the industry's major refiners and marketers through sale of one grade of motor fuel. Now it has gone to the opposite extreme with test operations launched recently at 17 stations in Orlando, Fla. *(The Oil and Gas Journal, February 27, page 82, and March 5, page 60).*

The company is selling five grades of gasoline from a single pump by blending at the hoze nozzle. The grades range from the Blue Sunoco distributed in all of Sun's marketing operations up to a 100-octane premium fuel.

Those predicting the general introduction of 100-octane motor fuel by Sun say this would be the logical result of the Orlando experiment. But Sun says it's too early to draw any conclusions regarding consumer attitude.

Competitors, some of whom have bought samples for testing, are watching the outcome as closely as Sun is.

Top octane favored . . . Reports by competitors from Orlando indicate that of the four new grades, consumers favor the premium 100-octane fuel. It sells for 5 cents above Blue Sunoco, which at 94 octane is midway between regular and premium grades distributed by most companies.

Consumer interest in the top grade leads to the prediction that Sun will eventually introduce 100 octane at all its stations.

The concentrate which is used for blending at the pump is presumably high-octane reformate and alkylate of suitable boiling range. The last two digits of the numbers are believed to indicate the percentage of the concentrate in the finished product. The 210 grade, for example, would contain 10 per cent of the concentrate.

The following table for the five grades is based on a Sun competitor's analysis of gasoline bought at one of the Orlando stations:

Grade—	Research octane	Price per gal.*
Blue Sunoco	94	28.9
210	95.3	29.9
220	96.6	30.9
230	98.0	31.9
250	100.5	33.9

*Includes federal and state taxes.

Automotive interest . . . Automotive companies also are watching the experiment with more than passing interest.

Some have obtained samples for road and laboratory testing. They feel it may prove to be the answer to the widely varying octane requirements of the same model engines from the same assembly line.

Offering multiple grades of fuel permits the motorist to select the octane required by his engine. As the requirement rises with use due to carbon deposits, he can buy an in-between grade for a moderate engine without going all the way to the top-priced premium. And the top octane will be available for engines which have such high requirements.

Consumer protection . . . The pump manufacturer says the customer can be assured he's getting precisely the grade he's paying for if he checks the designation while fuel is being delivered.

When delivery is completed the pump is locked at the seelcted grade. The manufacturer says it's impossible to tamper with the pump mechanism to make it deliver a grade of gasoline other than the one shown on the pump.

AN EARTH-FILLED island will replace this barge as an offshore site for oil drilling off California now that Richfield Oil Corp. has decided its first . . .

Core-Drilling Barge Pays Off

VENTURA, Calif.—Richfield Oil Corp. is pushing plans for an earth-filled drilling island offshore from the Rincon field after tests conducted from a floating barge indicated the 1,175-acre state lease will be oil productive.

Probably the first "oil well" ever completed from a floating platform was a 4,100-ft. test. After pipe was set, the well was tested for 6 hours through perforations. The hole was then pumped full of cement and abandoned.

Richfield used the floating barge to drill this and three other shallower core tests to determine the site from which development work could best be carried out. Key equipment which made this possible were a submarine blowout preventer assembly and wellhead spider *(The Oil and Gas Journal, February 27, page 130).*

Principal means for keeping the bit on bottom despite vertical motion of the barge was a torque converter in the hoist power train. Richfield's W. J. Travers, vice president, revealed to a press tour last week that weight on the bit varied within the range of two to eight points. The bit was on bottom all the time, however. Penetration rates compared favorably with those of land-based rigs, he added.

Following completion of the fourth core hole at Rincon, Richfield may move the barge offshore from Huntington Beach for additional core-hole work. There the company holds a joint lease with Signal Oil & Gas Co. and Hancock Oil Co. on 640 acres which extend 1 mile from shore.

Bids for the 200 by 200-ft. earth-filled Rincon drilling island must be submitted by April 1.

Citric Acid Is New Water-Flooding Aid

NEW YORK.—Several years' laboratory and field studies have proved citric acid to be valuable in secondary oil recovery. When the compound is incorporated into injection water, it curbs costly iron plugging, one of the major causes for flow stoppage in input wells.

The results were disclosed at the National Association of Corrosion Engineers convention here last week by P. E. Weber, chemical sales division, Chas. Pfizer & Co., Inc., Brooklyn.

Citric acid preferentially sequesters iron and thus prevents precipitation of insoluble iron salts in the presence of other metallic ions such as calcium and magnesium. By sequestering the iron, even in high-calcium waters, citric acid may obviate the use of such current workovers as reacidizing and refracturing the plugged sand faces. Hence the water-injection rate can be maintained at lower cost.

In water flooding the need for proper water treatment is universally recognized. Although the problems encountered throughout the country are similar, it is not possible to standardize on any single water-conditioning procedure. Many different treatments are in use today. Some are designed to improve the efficiency of the water as a flooding medium; others minimize difficulties such as corrosion, bacterial growth, and plugging of the interface.

How treating works . . . In open systems aeration removes dissolved acidic gases and reduces the corrosive tendencies of the water. Aeration is followed by chemical treatment and sedimentation to remove suspended material and reaction-precipitated solids. In closed systems it is sometimes necessary to do no more than filter the water, but this is the exception. Chemical treatment usually is required.

In either type of treatment, the objective is the same: to obtain maximum water injection rates at minimum cost.

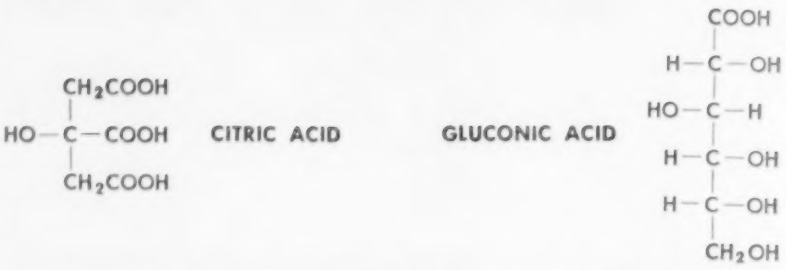
Iron plugging . . . Some methods to increase injection rates by opening up an iron-plugged well have only temporary effects. Injection rates will fall off as iron precipitates again build up at the interface. The addition of suitable sequestering agents to keep iron in a soluble form is a new answer to the iron-plugging problem.

Sequester means literally to retire or draw into seclusion. Chemically, the sequestration of a metallic ion is the act of retiring the ion from circulation and making it unavailable. Thus, sequestering agents are used to prevent precipitation.

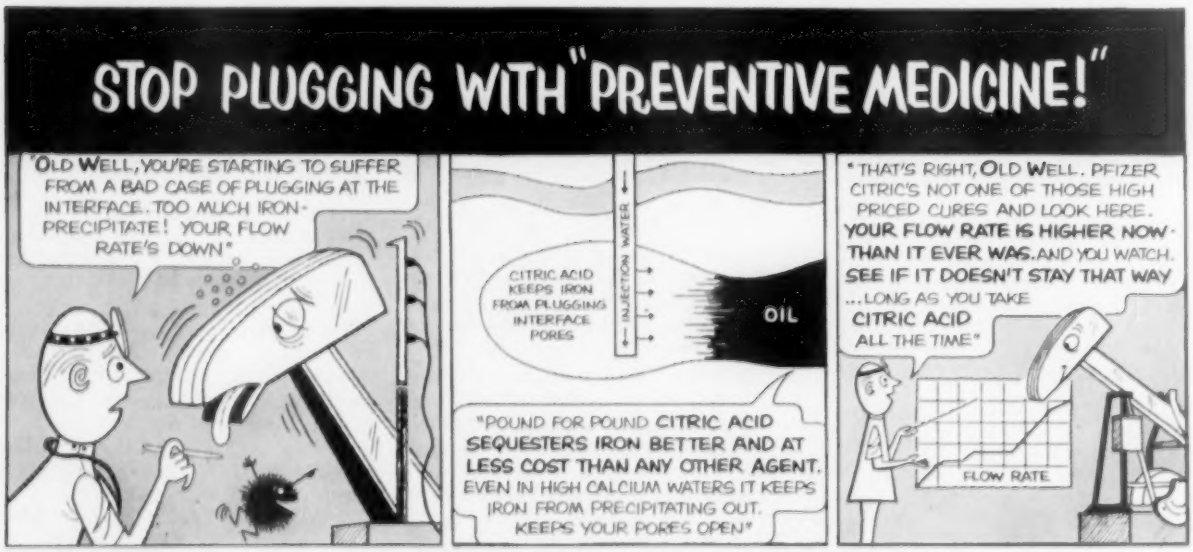
Citric and gluconic acids . . . These are naturally occurring hydroxy carboxylic acids. The acids and their salts have long been used as sequestering agents in a variety of industries.

The Pfizer research and oil-field studies show some specific advantage for the citrates and gluconates in preferentially sequestering iron. The precipitations of insoluble iron salts is prevented in the presence of other metallic ions such as calcium and magnesium. Corrosion products and precipitated iron salts will no longer prevent the free passage of water into the strata if citrates or gluconates are added to the injection water.

They also increase the efficiency of



ACIDS STOP IRON PLUGGING—Citric acid and gluconic acid are the latest answers to the iron-plugging problem in water injection. Anhydrous citric acid is a colorless, transparent crystal or white powder, odorless, with a pleasant acid taste. Solubility (at 25° C.) in water is 161.8 gm./100 ml. Gluconic acid is marketed as a 50 per cent aqueous solution, light brown, with specific gravity (50 per cent solution) of 1.24.


STOP PLUGGING WITH "PREVENTIVE MEDICINE!"
"OLD WELL, YOU'RE STARTING TO SUFFER FROM A BAD CASE OF PLUGGING AT THE INTERFACE. TOO MUCH IRON-PRECIPITATE! YOUR FLOW RATE'S DOWN"
INJECTION WATER
CITRIC ACID KEEPS IRON FROM PLUGGING INTERFACE PORES
OIL
"POUND FOR POUND CITRIC ACID SEQUESTERS IRON BETTER AND AT LESS COST THAN ANY OTHER AGENT. EVEN IN HIGH CALCIUM WATERS IT KEEPS IRON FROM PRECIPITATING OUT. KEEPS YOUR PORES OPEN"
"THAT'S RIGHT, OLD WELL. PFIZER CITRIC'S NOT ONE OF THOSE HIGH PRICED CURES AND LOOK HERE. YOUR FLOW RATE IS HIGHER NOW THAN IT EVER WAS. AND YOU WATCH. SEE IF IT DOESN'T STAY THAT WAY ...LONG AS YOU TAKE CITRIC ACID ALL THE TIME"
FLOW RATE

CARTOONS WILL BE USED by Pfizer Co. in public announcements on use of citric acid in flooding operations.

some bactericides which are ordinarily less effective in the presence of metallic ions. Iron is a particular offender in this respect and the citrates and gluconates apparently prevent any interaction between the bactericide and the metal ion.

Field practice . . . Citric acid and ammonium citrate in concentrations of 1 per cent and higher are used to remove rust and scale. Lower concentrations of citric acid (10 p.p.m.) will also remove rust and scale, but more slowly. Gluconic acid will act similarly.

The citrates and gluconates form complexes with iron on a mol-to-mol basis, and theoretically, about four parts of the citrate or gluconate will be required for every part of iron in the solution. In practice, 10 p.p.m. of citric acid is suggested as a starting point since this is now being used in the field with satisfactory results. In the actual field tests, no decline in water injection rates was observed when citrates and gluconates were included in the water.

First practical field application of citric acid was made 3 years ago. Results, Weber said, already are apparent.

Work on brine flooding has been undertaken in southern Illinois, North Texas, East Texas, Louisiana, and California. Fresh-water application are now being tested experimentally in Bradford and other Pennsylvania areas.

In some major water-flood programs, citric acid is being used on a large scale. Most citric acid is now being distributed through small chemical and service companies in oil areas.

Equipment Outlook Rosy

WASHINGTON.—Equipment manufacturers can look forward to a record-breaking 1956 business, the Commerce Department predicted last week.

Oil-industry spending for new plant and equipment this year will top 3 billion dollars. It will be more than a billion dollars over 1955, the department estimated.

The estimate of a $3,322,000,000 outlay for plant and equipment in 1956 is based on reports secured by the department through the first 10 weeks of the year. The outlay last year, originally estimated at a lower figure, was $2,798,000,000 and in 1954 it was $2,684,000,000.

The oil industry usually accounts for slightly less than 10 per cent of the total for all business. It will maintain that ratio this year, in which total spending for new plant and equipment by industry, business, and services is estimated at $35,000,000,000.

Refining BRIEFS

PITTSBURGH. — Gulf Oil Corp. plans a $35,000,000 construction program at its 183,000-bbl. Philadelphia refinery to improve product quality. Some of the new units will be in operation by the end of the year.

The project includes a 26,000-bbl. Platformer, 3,000-bbl. alkylation unit, two 20,000-bbl. Gulfiners, 22,500-bbl. visbreaker, a steam-generation plant, water-cooling tower, pump stations, and storage facilities for L.P.G.

WASHINGTON.—Another refinery is planned for the Bellingham-Anacortes area of Washington. Certificate for rapid amortization has been issued to New England Industries for a $20,000,000 plant. Straits Refining Co., Dallas, has announced a 10,000-bbl. daily refinery, primarily for avgas production, in that region and The Texas Co. is considering a plant of 35,000-40,000-bbl. daily capacity *(The Oil and Gas Journal, February 13, pages 81 and 87).*

NEW YORK.—California Oil Corp. will spend $1,000,000 to boost capacity of a Platformer from 10,000 to 12,500 bbl. per day at the Perth Amboy, N. J. refinery. Bechtel Corp. is primary contractor. Completion is due this fall.

PORT ARTHUR.—The Texas Co. will start June 1 on a major expansion of steam and electric-generating facilities at its 210,000-bbl. daily refinery here. Steam capacity will be boosted by about 32 per cent and electric-power capacity by 29 per cent. Three new steam units and a 15,000-kw. generator will be completed by September 1, 1957.

TOLEDO.—Standard Oil Co. (Ohio) will build new refining facilities costing $25,000,000 to $35,000,000 at its 28,000-bbl. Toledo plant.

The units will be designed to operate on sour crude. The company said engineering studies are still in progress to determine the type and size of processing units to be built. Addition of 30,000 bbl. of crude capacity has been talked. But a sizable amount of the outlay is expected to go for units to upgrade product quality.

NEWCASTLE, Wyo. — The Sioux Oil Co. refinery at Chadron, Neb., which has been shut down since 1954, is being dismantled and moved to Newcastle where the company has two plants in operation.

Sioux is expanding and modernizing its plants here. A Houdriformer is scheduled for completion next month, and capacity of the crude processing unit also is being increased. The company plans to install a L.P.G. unit later.

Deepest Oil Zone Squeezed

PORT SULPHUR, La.—The world's deepest well has taken another big jump toward its goal of becoming the world's deepest producer.

Richardson & Bass has squeezed cement into perforations both below and above the prospective pay zone to isolate it. Operator is now preparing to run a patch string of 5-in. casing from the surface to the top of the existing liner at 18,800 ft.

After this string is cemented, the I-L Humble-L.L.&E.-State Lease 2414 will be perforated to test what may become the world's deepest producing sand. The sand lies between 21,523 and 21,622 ft. It is reported from electric logs to be the most promising zone.

This zone may also be the same one that caused a bad "kick" while the well was drilling with 18-lb. mud in December, 1955. At that time the hole was cased to 19,752 ft. and big batches of medium-gravity oil circulated out while it was being brought under control.

To ease the problems of completing in the deep, high-temperature formations, Richardson & Bass has brought a new mud into play. This mud was developed by Magnolia Petroleum Co. for drilling the extremely high-temperature shales found in deep wells in the West Ranch field area of the Texas Gulf Coast. The "calcium surfactant mud" was successful in initial tests for Magnolia there, and it is now showing up well for Richardson & Bass in their hole.

Company engineers and rig crews report the mud shows little gel strength and is easy to maintain. A perforating gun was run below 21,500 ft. in the new mud and there was little resistance in either running or pulling it. Moreover, the mud showed no bad effects during or after the isolation-squeeze job at 21,522-23 ft.

Richardson & Bass used a lime-base mud in drilling the well to its total depth of 22,570 ft.

Sentiment for Crude Price Hike Grows

ECONOMIC pressures keep building up for a general increase in the price of crude oil.

One major company president states positively that higher costs make an increase inevitable. The question is no longer whether it will come, but when.

Cases for raising prices were made on two fronts last week, reinforcing the growing sentiment that a boost is essential to provide an adequate return on investment and assure a supply for the future.

Oil-finding costs up . . . Cost of finding oil has reached $2 a barrel, according to John H. Murrell of DeGolyer & McNaughton, Dallas consulting firm.

His talk evoked spirited discussion at the ninth annual Midwestern meeting of the Society of Exploration Geophysicists at Fort Worth. He asserted that $4 a barrel would be a more realistic price for crude than the going rate of $2.75.

Murrell said that current oil-finding costs compare with an average of $0.40 per barrel during the 1934-44 period and $1.13 for 1944-54. They have multiplied 2.8 times over the past 20 years while crude has gone up only 2.3 times.

Complete cost picture . . . L. F. McCollum, president of Continental Oil Co., said that a crude price increase is definitely on the way, and presented a complete rundown on increased costs absorbed by the oil industry to support his case.

"It will be only a matter of time until the market must give recognition through price advances to the steadily rising costs which all crude-oil producers are experiencing," McCollum told the Houston Society of Financial Analysts. His prediction was in response to a question which followed his formal address before the financial group March 9.

"The need for higher crude prices has been apparent for some time and is rapidly becoming more urgent," McCollum said. He pointed out that there had been only one general crude price increase in the past 8½ years. That increase, amounting to 25 cents per barrel, was in June 1953.

"At approximately the same time, corresponding upward adjustments were made in the prices of most refined products," McCollum continued.

"Since 1953, the oil industry, not unlike many other American industries, has faced sharply rising costs in nearly all phases of its operations which have been only partially reflected in refined product prices and, as yet, not at all in the prices of crude oil."

L. F. McCOLLUM
. . . "Only a matter of time . . ."

The Continental president listed four major areas in which prices affecting the oil industry have spiraled:

. . . Finding and developing crude oil. Here, McCollum said, costs "have continued their persistent, upward climb." He cited a report by a committee of the Independent Petroleum Association of America which indicated the amount of oil found per foot drilled dropped from 25 bbl. in 1945-49 to 17.25 bbl. in 1950-54.

. . . Wages and salaries. The recent general wage hike was the sixth granted by the oil industry in the past 7 years. Cumulative increases since December 1949 total 68 cents an hour, or 37 per cent. Half of the wage hike has gone into effect since the last crude price increase.

. . . Equipment, materials, and supplies purchased from other industries.

"To cite but a few examples," McCollum said, "it is estimated that between June 1953 and August 1955, the cost of tubular goods increased 10.2 per cent, structural steel 17.9 per cent, and construction costs 11.2 per cent. These and other price advances in our purchased materials and supplies have been a natural consequence of the general upward movement in wages and costs throughout our entire industrial economy."

. . . Continual advances in gasoline octane numbers. These advances "have been demanded by the public and required by many of the new automobile models," McCollum said.

In the past 2 years, he added, Continental has increased its expenditures for tetraethyl lead by almost $2,500,000. In addition, the increase in octane numbers has required heavy capital expenditures for new processing facilities at several Conoco refineries.

Anticipated costs for Continental this year will be about $11,000,000 more than in 1955. McCollum predicted about $4,000,000 of this increase will be needed to meet price increases in equipment, materials, and supplies; $3,000,000 will cover the recent wage boost; $2,000,000 will be spent in the octane race; and $1,500,000 will go for anticipated hikes in freight costs.

"These figures, moreover, make no allowance for the most important cost increase—namely, the added expense associated with deeper drilling and the steadily increasing difficulty of locating new oil reserves.

"We have every reason to believe that other oil companies are facing cost increases of comparable magnitude for the year 1956. Therefore, the economic pressures for price advances are becoming very strong.

"Actually, crude-oil producers are now liquidating their existing crude-oil reserves at prices which reflect the finding costs of earlier years rather than today's replacement costs."

More reserves needed . . . He said Chase Manhattan Bank estimates domestic demand for petroleum products will increase about 53 per cent in the next 10 years and will reach about 12.8 million barrels a day in 1965.

On the assumption that about 25 per cent of our crude needs will come from foreign fields in 1965, it is estimated that the oil industry will have to find and develop about 36 billion barrels of new crude-oil reserves before that time.

"The capital investment required to discover and develop the necessary domestic reserves is estimated at about $51 billion. Clearly, the industry has little hope of generating internally or attracting from outside sources a sum of such magnitude unless crude-oil prices are advanced in accordance with rising costs and maintained at levels which will permit a reasonable return on the stockholder's investment."

Without an increase in the price of crude, McCollum warned, investments in exploration will be discouraged "and we will inevitably move into a period of shortages." As a result, this country may become more dependent on foreign crude than would be prudent from the standpoint of national policy.

FPC Plans New Move

Gas producers may have to file annual sales report

WASHINGTON. — Independent gas producers face the threat of having to file annual reports of their sales and revenues with the Federal Power Commission.

The FPC announced last week that it plans to adopt a rule putting producers under the accounting and reporting requirements of the Natural Gas Act.

It has given interested parties until March 29 to file their views and comments. These will be considered before any action is taken. But since the commission adopted the idea by a 4-to-1 vote, observers expect the rule will go through.

Under the FPC's plan, producers will have to file a detailed statement by May 1 of natural-gas sales made during 1955 under their filed rate schedules and the total of sales made under any other arrangement.

Producers were exempted from the reporting provisions of the act in 1954. But the FPC says it now finds reports "essential to its proper administration of the act." The exemption from other reporting and accounting requirements will be continued, however.

Only Commissioner Seaborn L. Digby opposed the order. He held it would impose an unnecessary hardship upon the independent producers.

Wilmington Faces Cutback

LOS ANGELES.—The subsidence rate at Long Beach has prompted the city's board of harbor commissioners to order a cutback in oil production from tideland wells.

The action will affect only 45,000 bbl. of the 105,000-bbl.-daily production in the Wilmington field.

Fluid and gas withdrawals over a period of about 20 years has resulted in some parts of the harbor area sinking as much as 22 ft. Engineers estimate that ultimate subsidence in the center of the bowl-shaped critical zone will be as much as 35 ft. *(The Oil and Gas Journal, November 28, 1955, page 48).*

The board ordered the harbor department staff and city attorney to prepare cutback rate recommendations and submit them as soon as possible.

Koppers, Brea Pick Site

LOS ANGELES.—Koppers Co., Inc., and Brea Chemicals, Inc., a Union Oil Co. subsidiary, have selected a site and will begin immediate construction of a $10,000,000 polyethylene plant in Wilmington *(The Oil and Gas Journal, November 28, 1955, page 64).*

The plant will consist of two major units. One will manufacture ethylene from refinery gas. The other will process the ethylene into low-pressure polyethylene using the Ziegler process license held by Koppers. The plant will have an ultimate capacity of 60,000,000 pounds per year.

Brea will operate the plant with technical assistance by Koppers chemical division. Engineering, design and construction of the plant will be under the supervision of Koppers engineering and construction division.

Refinery gas for the plant will be supplied by Union Oil Co.'s refinery 3 miles south of the new facility. The plant will be completed sometime in mid-1957.

Champagne 'Launches' Coastal Wildcat

REDONDO BEACH, Calif.—Drillers are making hole below 1,500 ft. at a novel California coastal well after a bottle of champagne broken across the bit launched the venture.

The well is the 1 Redondo Beach of Signal Oil & Gas Co., Reserve Oil & Gas Co., and Artnell Oil & Gas Co. Santa Fe Drilling Co. is contract driller. The test is the first to be whipstocked into a portion of city-owned tidelands extending seaward 3 miles. Six wells will be drilled from the same site.

Signal, as operator of the well, was required to sound-proof the derrick and comply with extensive landscaping regulations around the well (see photo above). The drill site is on the north edge of this beach town against a heavy boulder breakwater.

The city has a big interest in the well. If oil is found in paying quantities, Redondo Beach will retain from 18 to 50 per cent of the gross sale price of the oil sold, depending on amount of production. All exploration and production costs will be paid by the oil companies.

Citizens voted to approve the contract with the three companies last November. Until then all drilling in the area was prohibited. The city's share of the income has been earmarked for developing a small boat harbor and concession area and to build a more extensive breakwater.

Alaskan Line Thawed Out

ANCHORAGE.—The Alaskan Products Pipeline is back in operation after being shut down for part of the winter by line freezes.

Since January, maintenance crews have been systematically locating and removing ice plugs from the line. The plugs formed in sags along a 100-mile section of the line through Canada's Yukon Territory. The line through this section is laid above ground. Temperatures this winter reached as low as —40° F., causing solid plugs of ice to form from small amounts of entrained water in the products.

Steel Orders Pile Up

- **Record drilling level, pipeline building keep mills hopping to fill oil-industry needs.**

- **But despite heavy backlog of orders, oil men aren't worried over a future steel shortage.**

THE record level of oil-industry activity has steel mills straining to meet drilling and pipeline requirements.

A year ago supply men were beating the bushes for business. Soon afterward a deluge of orders put them into a hole which they are still trying to get out of.

Just how bad is the steel situation?

Appraisals from steel men run very widely. It's merely a continuation of a tight situation that has been with us for 10 years, according to some. Others call it the tightest in history.

A survey by the Journal discloses that:

. . . **Oil country** tubular goods are booked through the second quarter of this year.

. . . **Line pipe** is booked into the second quarter of 1958 on some sizes.

. . . **Outlook** is for the situation to get worse before it eases up.

Oil country . . . Oil-country stocks are tied up only through the second quarter because houses won't take orders any farther ahead. Some firms say their books would be in the same shape as on line pipe if they accepted orders that far in advance.

"Oil country is terrible," the president of one supply company said. At first 5½-in. casing and tubing were short. Seven-inch and larger casing was readily available. Now everything is tight. Alloys are described as "almost precious as gold."

N80 high-strength and deep-well grades are particularly tight. The record total of 56,682 wells drilled last year ate up all surplus stocks. Drilling generally is running ahead of last year with completions up 7 per cent through March 1. Added pressure on tubing and casing is coming from increased drilling in the deep West Texas, Gulf Coast, Louisiana Gulf (including offshore), and Southeast New Mexico areas.

Line pipe . . . Line pipe has been tight for several years in the face of a continuing construction boom, particularly of big-inch natural-gas lines.

But this is the first time, according to supply men, that they've been booked up 2 years ahead. Some mills report 2-6-in. is booked up through the second quarter of 1958, but one small one is promising deliveries within 30 days.

Six to 8-in. welded pipe orders are being taken for the first quarter of 1957 by one major supplier. His books for seamless line pipe are closed through the second quarter of '57.

Another is sold out of 6-in. and less through '57. This supplier is well into '57 on big-inch orders. Another mill isn't taking orders on 16-in. and bigger before the third quarter of 1958.

Part of the trouble on small sizes is traced to reluctance of some mills to take orders for 6-in. and below. Labor costs are the same as for rolling 16-in., and it takes several miles of little inch to build up any tonnage. Orders for little inch often stand a better chance if accompanied by an order for larger size pipe.

A sizable chunk of big-inch tonnage is being taken by the Trans-Canada pipeline. The 34-in. leg from Alberta to Emerson, Man., is expected to get under way this year.

Outlook . . . The oil industry took a record 5,436,688 tons of steel products last year, over 2½ times its 1945 consumption.

Ingot production is expected to rise this year from 117,001,000 tons to about 120,000,000 tons. Pipe will be available from new mills. Greater output can be expected from existing mills, which are operating above the 93 per cent of capacity which they averaged last year.

The question is whether that will be enough.

Oil men believe it will.

Companies report a normal 6 to 8 months' supply of oil country on hand. But mills blocked out January deliveries and part of April in an attempt to get current on their orders. So that tonnage is lost.

Some majors report they're able to get only two-thirds to three-fourths of the tonnage they would like to have. They insist they aren't overbooking to beat a price increase which is taken for granted this summer when the steelworkers' contract comes up for renewal ("We aren't in business to make money on steel."). And they also say they aren't ordering to protect themselves against a future shortage.

No one goes so far as to predict steel will get short enough to curtail drilling this year. This reflects the confidence born of many years of squirming out of tight spots by swapping out or buying on the world market.

Pipeline men are too pleased with the continuing construction boom to worry very much about steel. They aren't having to wait for pipe yet in this country, although some holdups have been reported on South American jobs.

But the mills can expect more, not less, pressure from pipeline building. This year gives every indication of being bigger than last. Over 12,000 miles of gas-transmission lines alone are under way, approved, or submitted to governmental bodies in the U. S. and Canada.

Steel suppliers expect to catch up on line pipe by 1958. They base the reasoning on three assumptions: some planned projects will fall through, new capacity will be built, construction will taper off. It may not be wise to count too heavily on the last point, however. A letup in building has been forecast annually for some years now, but it refuses to come.

Pipeline Planned

Phillips to link plants to new industrial tract

HOUSTON.—Phillips Petroleum Co. has obtained an easement for a pipeline extending from its Adams Terminal to the site for a proposed petrochemical center on the Houston Ship Channel.

The pipeline, about 5 miles long, would permit Phillips to move products from its petrochemical plants to other manufacturers which may locate in the industrial area. Phillips announced plans earlier to invite other companies to locate plants on the 950-acre tract *(The Oil and Gas Journal, March 12, page 84)*. Phillips said it would exercise its option to purchase the industrial tract for approximately $3,000,000.

Easement for the proposed pipeline linking the two industrial sites was granted by the Houston Port Commission. Cost to the company was $15,000.

Phillips also has made arrangements to use facilities of Port Terminal Railway Association if trackage is extended to the 950-acre tract. Plans call for possible construction by various companies of a $100,000,000 chemical and petrochemical center.

Strike Made 40 Miles Offshore

MORGAN CITY, La.—Phillips Petroleum Co. has completed a gas-distillate discovery 40 miles off the coast of Louisiana to establish production a record distance from shore.

The discovery is in Block 184, Eugene Island area, off the coast of St. Mary Parish.

Designated the Phillips A-1 Dome A, the well flowed at the daily rate of 138 bbl. of 49.1°-gravity distillate and 6.9 million cubic feet of gas through small choke. Calculated potential on open flow is 65 million cubic feet of gas and 1,300 bbl. of distillate per day.

Production is from a Miocene interval at 14,808-36 ft. Shallower shows also were reported at 14,578-14,708 ft.

The discovery was the first test drilled in the 10,000-acre tract leased by Phillips from the federal Government in October 1954. The company paid $7,332,000 in bonuses for leases on Blocks 184 and 172 which adjoins it on the north. Each block covers 5,000 acres.

At the time the test was spudded last summer it was farther from shore than any well previously drilled *(The Oil and Gas Journal, August 8, 1955, page 69)*. Since then Gulf Refining Co. has moved farther from shore to drill tests in Block 253, West Cameron area, and in Blocks 179 and 180 Vermilion area. The three Gulf tests, each about 50 miles from shore, were recently abandoned.

The Phillips discovery was drilled in 85-ft. water from a self-contained stationary platform. Six wells can be drilled from the single location.

Nearest production is in Block 128 field 12 miles to the north. Several companies now have oil production in this field which covers portions of several adjoining tracts and is rated one of the major offshore discoveries. Latest producer in that general area is an oil well recently completed by Phillips in Block 129-A *(The Oil and Gas Journal, March 12, page 206)*.

Previous record for the farthest production from shore was held by Gulf Refining's discovery in Block 154, Ship Shoal area, about 35 miles from shore *(The Oil and Gas Journal, August 22, page 98)*.

Phillips is now building a platform about 1½ miles north of its Block 184 discovery. The company plans to start drilling at that location next month.

Elk Hills Flood Proposed

BAKERSFIELD, Calif.—A plan for injecting water in shallow sands on the southeastern flank of the Elk Hills field is expected to get the Navy Department's approval within the next few weeks.

The Navy, for which Standard Oil Co. of California acts as operator in the Elk Hills Petroleum Reserve, has resorted to full production of all downstructure shallow wells to prevent the crude from migrating into water sands. This method has helped, but an estimated 3,000 bbl. daily still is being lost.

With water being injected downward, it is expected the oil migration can be further curbed. About 27,000 bbl. of brine being produced with the 16,000 bbl. daily crude output is available for reinjection.

Island Test Finds New Zone

LOS ANGELES.—Monterey Oil Co. has discovered a new shallow pay zone from its drilling island 1½ miles offshore from Seal Beach.

The discovery well is the 101 Monterey-Texas. The test was directionally drilled to a total depth of 3,965 ft. with bottom a considerable distance laterally from the island site. On a test the well produced by gas lift 347 bbl. of 20.7°-gravity crude in 24 hours.

The 10 wells drilled previously from the 75-ft.-diameter island are producing from a deeper zone at 6,000 ft. Double decking of the island has been completed and will permit as many as 70 wells to be drilled from it.

Barber Closes Kirby Deal

HOUSTON.—Barber Oil Corp. announced last week that it has acquired oil exploration and development rights on approximately 290,000 acres in the upper Gulf Coast region of Texas and Louisiana.

Operations will start immediately and will be conducted by Oil Reserves Corp., wholly owned subsidiary of Barber.

Oil rights were obtained from Kirby Lumber Corp. Negotiations had been under way for several months *(The Oil and Gas Journal, January 23, page 54)*.

Gasoline Plant Is Sold

SWEETWATER, Tex.—Sinclair Oil & Gas Co. has bought for an undisclosed price a gas-products plant built and operated at the Sweetwater municipal airport by Rowan & Hope.

The plant now processes about 2,300,000 cu. ft. of oil-well gas daily from the Lake Trammell field and produces roughly 6,000 gal. of propane, butane, and natural gasoline.

Sinclair plans to build a second plant on the same site to process oil-well gas from the Sweetwater (Canyon) field. This project also will include a field gathering system and a booster plant in Nolan County. The combined production of the two plants will total about 20,000 gal. of liquids daily. Sinclair discovered the Canyon field last year and now has 26 wells there.

Navy Plans Oil Search

Funds sought to conduct core drilling on San Nicholas Island off California coast; Congress must approve plans

WASHINGTON.—A new venture in developing naval petroleum reserves is planned by the Navy, if Congress approves.

The department wants to test the oil possibilities of San Nicholas Island, 60 miles southwest of Ventura County, California. Studies by the U. S. Geological Survey last year indicated that conditions are favorable. Congress has been asked to provide $529,000 for further exploration and test drilling.

The Navy is under long-standing instructions from Congress and more recently from the National Security Council to try to find additional oil reserves. It has long had San Nicholas Island in mind as a possible reservation.

There are today four naval petroleum reserves. But only the one at Elk Hills, Calif., is actually being held as a hedge against a future emergency. In event of need, a sustained production of 100,000 bbl. daily could be quickly secured and as much as 150,000 bbl. could be taken for brief periods.

A thorough test of the long-shut-in Teapot Dome reserve in Wyoming, which never proved to have 10 per cent of the more than 100,000,000 bbl. originally estimated, has shown that only 8,000 to 10,000 bbl. could be developed. During the last war a study was made but it was decided that the limited amount of oil that could be secured was not worth the steel, money and manpower that would be required to get it.

The area is still held by the Navy but it is expected that eventually Congress will order its disposition, possibly through lease.

The Buena Vista, Calif., reserve is all leased so far as shallow resources are concerned. There has been no exploration below 5,000-6,000 ft., however, and any deep zones it may contain are being held intact.

Exploration of the possibilities of of Naval Reserve No. 4 in Alaska over a term of years at a net cost of some $47,000,000 failed to develop any real prospect of oil.

San Nicholas . . . San Nicholas Island is about 8 miles long and 3 to 4 miles wide. It was originally much larger, but has lost considerable area through erosion. This has left a shallow belt around the island which is perhaps 25 miles long to the northwest and much narrower to the east and south.

The island is one of three off the California coast which are held by the Navy. There is no present intention of exploring San Miguel or San Clemente islands, the other two Navy holdings. But if the test of San Nicholas proves productive, it is possible those islands, too, will be investigated.

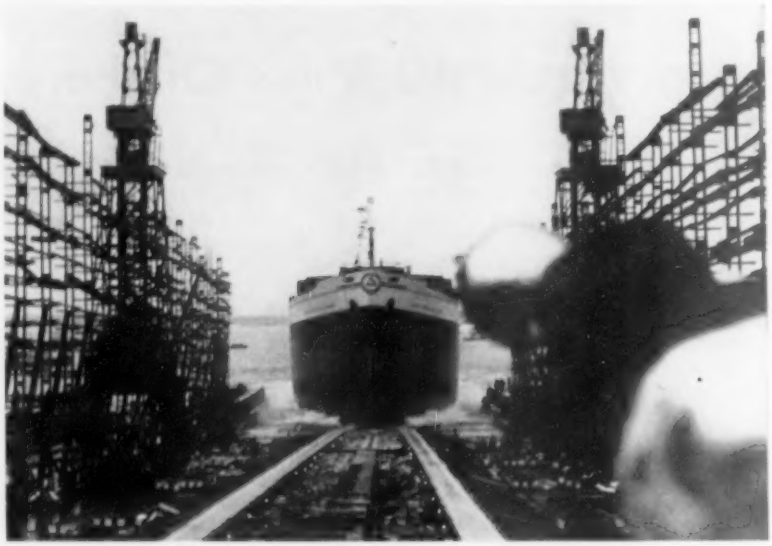
The department's plans for San Nicholas call for spending $49,000 for further studies by the Geological Survey. A 2,500-ft. core hole will be drilled at a cost of $25,000. If it proves encouraging a test well will be sunk to a depth up to 8,500 ft., at a cost roughly estimated at $450,000.

Background . . . San Nicholas Island was spotted by geologists as a possible oil source well over 30 years ago. California interests made an unsuccessful attempt to secure prospecting permits under the Mineral Leasing Act in 1930, while the island was still under control of the Commerce Department.

The area was taken over by the Navy in 1933 for a gunnery range. At that time its oil possibilities were noted.

An initial study of the island was made in 1937 by the office of naval petroleum reserves. The matter was not considered urgent at the time. Interest lapsed until the Navy virtually completed exploration and development of Elk Hills, drilled completely through the section on Teapot Dome and wound up its search in Alaska.

A decision to make a further examination of San Nicholas was reached in July 1954. In December a preliminary survey was ordered, and the Geological Survey made the study last year.



New Tanker Record Claimed

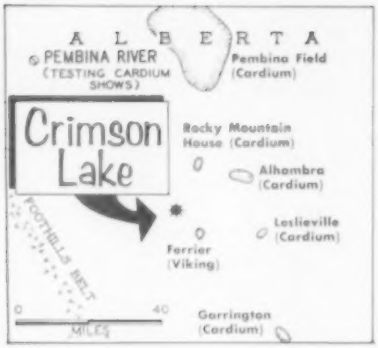
SPARROWS POINT, Md.—The S. S. Cities Service Baltimore, the biggest tanker built to fly the U. S. flag, has been launched at Bethlehem Shipbuilding Co.'s shipyard here.

The ship is the first tanker to be built under the Maritime Administration's "trade-in-and-build" program, and is the world's largest tanker designed to carry multiple grades of products.

Capacity of the vessel is double that of a T-2 tanker. It can carry a total of 273,175 bbl. of 18 different products, including automobile and aviation gasoline, heating oils, kerosine, and industrial and lubricating oils. The 32,000-ton vessel is 661 ft. long, has a 90-ft. beam and a 33-ft., 11½-in. draft.

The tanker and two sister ships now under construction at Sparrows Point will operate between the company's Lake Charles, La., refinery, and Cities Service terminals along the Atlantic Coast.

Cities Service is replacing seven tankers of the T-2 class with the new ships. Under the Maritime Administration's program, designed to modernize the American-flag tanker fleet, tankers at least 10 years old may be turned in for lay-up in the reserve fleet. The addition of the new ships and the deduction of the T-2's will place Cities Service's fleet at 19 tankers.



Cardium Gas Tapped

Crimson Lake wildcat is gas-condensate prospect

CALGARY.—The first gas-condensate production from the Cardium in the foothills belt of Alberta was claimed last week at the Crimson Lake wildcat of Great Plains Development Co. of Canada.

The firm's 9-23A Crimson Lake, located 12 miles northwest of the town of Rocky Mountain House, flowed gas at the rate of 5,200 M.c.f. per day on a drill-stem test. The test was of the Cardium sand at 7,593-7,613 ft. A sizable recovery of yellow-green distillate was reported when pipe was pulled. Drilling has resumed, and the well is below 8,387 ft., scheduled as a Mississippian test.

The wildcat is located 7½ miles northwest of Ferrier (Viking) oil field and 12½ miles southwest of Cardium oil production at Rocky Mountain House field. If proven, it would be the first gas-condensate Cardium field.

Attention also focused last week on another Alberta test.

Southern Production - Canadian Atlantic's Pembina River wildcat reportedly found shows in the Cardium. Location is 28 miles west of Pembina field. At last reports the operators were testing.

New Joint Strengthens Tubing

HOUSTON.—A newly developed sealed tubing joint has been introduced to the oil industry for use in high-pressure production and slim-hole drilling.

The joint uses an acid and heat-resisting seal, Teflon, which remains stable at temperatures ranging up to 574° F. Developers of the joint claim it is so designed that pressure does not reach the threads.

A new company, Hardy-Griffin Engineering Corp., developed the device and is scheduled to start production immediately.

John M. Hardy, former superintendent of Baker Oil Tools, Inc.'s Houston plant, is president of the new concern. Executive vice president and one of the designers of the sealed joint is W. H. Griffin, formerly with Baker Oil Tools, Camco Gas Lift, Welex Jet Services, Inc., and Johnston Testers, Inc. Also associated in the venture is William B. Taylor, former president of Johnston Testers.

Hardy-Griffin claims the new joint, known as the HGT Sealed Joint, will withstand any pressures encountered in high-pressure production or in modern slim-hole drilling methods.

The company will produce an "all-purpose" sealed tubing joint for use in single tubing string production completions, remedial work, and slim-hole drilling. A smaller-diameter tool, called the HGT "Super Slim" sealed tubing joint, will permit use of parallel strings of tubing for dual completion of high-pressure zones.

JOHN M. HARDY
. . . a sealed tubing joint.

How it works . . . Because of the design of the joint, it does not have to be tightened severely to form a seal. Therefore, the joint makes up without severe torque and damage to the threads.

In the new joint, the pin and box are on corresponding tapers with the auxiliary Teflon seal on the pin. If damaged, the seal can be replaced at the well site without special tools.

Small Firm May Triple Size

DENVER.—Great Basins Petroleum Co., headquartered here, will more than triple its assets if stockholders approve a deal to acquire three other firms.

Shareholders will meet here April 11 to vote on a stock-transaction with Lincoln Oil, Gas & Refining Co., Denver, Lincoln Petroleum Co., Los Angeles, and Brown Well Service Co., Odessa, Tex.

Combined assets of the three firms to be acquired will top $10,000,000. The two Lincoln companies, unrelated, have production in nine states and unexplored leases covering 400,000 acres in 12 states and Canada. Brown, which also manufactures and repairs tools, operates in the Texas-New Mexico area.

Stockholders also will vote on increasing authorization of Great Basins' $1 par value stock from 5,000 to 10,000 shares.

More Gas for Sacramento

SAN FRANCISCO.—Pacific Gas & Electric Co. soon will begin an 83-mile pipeline to carry more Glenn County gas into the Sacramento region.

The $5,250,000 project will run from the Beehive Bend field near Willows to a point near Davis, then easterly to Sacramento. It will include 37 miles of 20-in., 37 miles of 18-in., and 9 miles of 12-in. line. P.G.&E. has delayed awarding contracts pending settlement of strikes which have held up pipe supply.

Production from 10 wells in the Beehive Bend area now goes into Sacramento through an existing line on the east side of Sacramento valley. P.G.&E. construction crews are adding a 6-mile gathering system to tie in 10 more wells.

Clareton Well Reopened

CHEYENNE, Wyo.—The Wyoming Oil and Gas Conservation Commission has allowed R. L. Manning Co., Denver, to return its 1 Cedric well in the Clareton field to production.

A total of 169 Clareton wells producing more than 5,000 cu. ft. of gas per barrel of oil were shut down by the commission last year. The Manning application, a hardship case, was the first exception allowed in the field.

A CITY ON WHEELS was manufactured for the oil search in Somalia at Spartan Aircraft Co., Mobile Homes Division, in Tulsa. The 19 trailers are being shipped to Houston where they will start the trip to Somalia this week.

Rig Heads for Somalia

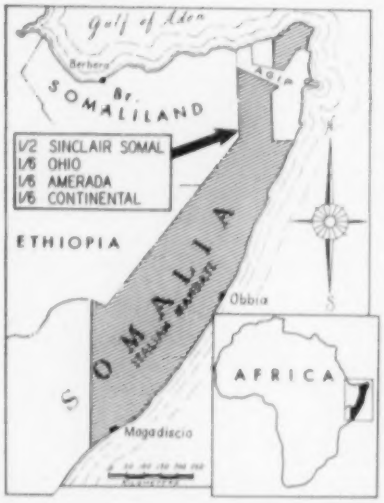
Four companies with Sinclair as operator will launch program this summer in country on Africa's east coast

SINCLAIR Somal Corp. will soon begin a race with the Indian Ocean monsoons in an effort to get a drilling rig and other equipment to Somalia before the foul weather season.

Sinclair Somal, a subsidiary of Sinclair Oil Corp., plans a deep wildcat in the remote and as yet untested country of East Africa. Before it became a United Nations trust territory under Italian administration, the country was Italian Somaliland.

Sinclair Somal owns half a 92,000 sq. mile concession, just slightly less than half the entire country. The other half of the concession is divided equally between Continental Oil Co., Ohio Oil Co., and Amerada Petroleum Corp. Sinclair Somal will act as operator for the group.

The two-part American company concession is split by an 11,000-sq. mile concession held by Azienda General Italian Petroli (A.G.I.P.), the Italian government company. The smaller portion of the American concession is on the tip of Somalia where the Indian Ocean joins the Gulf of Aden. The larger portion where the wildcat will be drilled extends southward for more than 700 miles along the Indian Ocean.



The drilling rig and other equipment is now being assembled in the United States for shipment to Somalia where it will be unloaded from a charter vessel in a beach landing about the middle of May.

The landing operation will be made at Obbia, about 350 miles northeast of Mogadiscio, capital of Somalia, and the country's only port. Barges will be lowered over the side of the ship to float the drilling equipment and supplies ashore along an unprotected stretch of the beach. Thus the need for beating the monsoon season of early summer in the Indian Ocean.

New driller . . . Contract for the drilling operation has been let to a new drilling company which will also supply the camp, transportation, and other equipment for the operation. The contractor is International Drilling Co., N.V. The firm was recently organized in the Netherlands. Partners in the drilling company are Monty R. Garrison and Wallace W. March. Garrison was formerly general manager of Nederlandse Boormaatschappij, N.V., owned 51 per cent by Drilling & Exploration, Inc. March is former executive vice president of Drilling & Exploration.

The new company has opened offices in The Hague and Rome and plans to open a third in London. H. R. Stephens, formerly in Venezuela and Colombia with Shell, will have charge of the Somalia operation for the drilling concern.

Sinclair Somal has been doing surface geology, gravitometer, and magnetometer work for more than 2 years on its acreage. The Italian government company has done surface work on its concession for about the same period of time.

Adjoining concessions . . . In addition to the Somalia concession, Sinclair holds the concession over the entire country of Ethiopia, adjoining Somalia on the west. Sinclair has one rig in Ethiopia.

The other half of the corporation—Continental, Ohio, and Amerada—have a concession covering 36,000 sq. miles in British Somaliland. A portion of this concession is adjacent to the Sinclair Somal concession. The British Somaliland concession is held under the name of Conorado Petroleum Corp., which is owned jointly by the three companies.

Esso Plans German Plant

Esso A. G. will start work soon on a new 50,000 to 60,000-bbl. daily refinery at Cologne, West Germany.

The plant is expected to go on stream late in 1959. The capacity may be raised to around 100,000 bbl. daily after construction starts.

The new refinery will be farther south and east than any now located

in Germany. Discussions are under way to decide the location of a pipeline terminal. The line would carry crude from a North Sea port, possibly Rotterdam, Wilhelmshaven, or Emden.

De Mares Deal Near

Colombia water-flood job negotiated by U. S. firm

OFFICIALS of Forest Oil Corp., Bradford, Pa., and Empresa Colombiana de Petroleos are negotiating a contract for Forest to conduct water-flood operations on part of the old De Mares concession.

Dale H. Dorn, Forest president, of San Antonio, Tex., was in Colombia last week. Company officials at Bradford declined to comment on the status of the Colombian talks. But it was understood a contract is expected to be signed sometime this month.

Forest has a strange agreement with Colombian officials giving it exclusive rights to negotiate on the water-flood deal. Forest thus is protected from interference by competitors while negotiating.

The area under consideration for secondary recovery work is composed of about 20,000 acres in the La Cira and Infantas fields of the big De Mares concession.

Officials of the Colombian government-owned company have been reported trying to interest foreign operators in a water-flood project for some time. American consulting engineers are known to have done preliminary work on the project. The government, however, is reported reluctant to invest capital in the project, wanting the operator to undertake the financing for a share in any increased production.

De Mares concession is one of the oldest in Colombia. It was obtained by Roberto de Mares, a Colombian, prior to 1900 and consisted of 2½ million acres in jungle country of Santander province on the upper Magdalena River valley.

First production was discovered in 1917-19 by Tropical Oil Co., which had become interested in the project. International Petroleum Co., a subsidiary of Imperial Oil, Ltd. (Jersey Standard) later acquired Tropical and took over development of the concession.

At the time the concesson expired and reverted to the Colombian Government in 1951, De Mares production was 38,000 bbl. daily with reserves estimated at 140,000,000 bbl. Production in 1955 was reported at 31,925 bbl. daily.

This steady drop in production prompted Empresa officials to study water-flooding as a secondary-recovery measure to extend life of the field.

12 Firms Share Turk Grants

AFTER 5 months of negotiation, the Turkish Petroleum Administration announced last week it is ready to grant 141 exploration concessions allowing a dozen oil companies to look for oil over 35,000 sq. miles of the country's territory.

Turkey previously had granted acreage to a number of the companies. Five firms received 14 licenses late last year when it was determined none of the applications overlapped. *(The Oil and Gas Journal, December 12, 1955, page 77).* A month later another 21 exploratory concessions in Thrace, the European portion of Turkey bordering Greece and Bulgaria, were granted seven companies when conflicts in applications were resolved *(The Oil and Gas Journal, January 16, 1956, page 89).*

Reports from Ankara last week indicated that the 141 licenses now cleared by the petroleum administration represent the remainder of the applications filed last October after the new Turkish law was amended and put into effect. When the first conflicts were settled by negotiation early in January, a number of the companies filed for additional acreage at the invitation of the government. The conflicts involved in these additional requests for acreage are still to be settled.

The exploratory licenses are limited to a maximum of 100,000 acres and are for a 6-year period, with a possible 2-year extension for each. The law provides that surface exploration must be undertaken almost immediately after the license is officially granted. Drilling must begin within 5 years. Most of the companies involved have already done a great deal of surface work in Turkey.

The reports from Turkey last week failed to give any acreage figures for the individual company license, but the companies and the number of licenses granted each were listed. They are:

... **Esso Standard (Turkey), Inc.,** (Jersey Standard), 27 licenses.

... **Mobil Oil Turk, S. A.** (Socony Mobil), 24 licenses.

... **N. V. de Bataffsche Maatschappij** (Royal Dutch-Shell), 21 licenses.

... **Tide Water Associated Oil Co.,** 17 licenses.

... **Turkiye Petrolleri Anonim O.** (Turkish Petroleum, Inc.), the government-controlled oil company, 15 licenses.

... **American Overseas Petroleum, Ltd.,** (Caltex), 13 licenses.

... **Istanbul Natural Gas Co.,** five licenses.

... **Bolsa Chica Oil Corp.,** Los Angeles, five licenses.

... **Husky Oil Co.,** Cody, Wyo., four licenses.

... **D. D. Feldman Oil & Gas,** four licenses.

... **C. Deilmann Bergbau,** GmbH., four licenses.

... **Gilliland Oil Co.,** Los Angeles, two licenses.

Israel Offset Hits

Well expected to produce 300 to 500 bbl. per day

A DRILL-STEM test of an offset to the Heletz discovery in Israel indicates that the new well will be at least as good, if not better, than the discovery.

The 3 Heletz flowed at the rate of about 83 bbl. an hour, or 2,000 bbl. daily, on a 20-minute test. Geologists on the scene expect the well to flow from 300 to 500 bbl. per day on production. The pay tested, the second of two found, is the zone which currently produces about 260 bbl. daily from 1 Heletz.

Drilliing continued after the test and a 5-ft. saturated sand was encountered a few feet deeper. Below that section the well struck a sandstone which appears to be oil saturated. The well will be continued in search of a much thicker section which is believed to lie about 200 ft. deeper.

No. 3 is 1,300 ft. north and slightly east of the discovery, which found the first of two sands at the top of the lower Cretaceous at 4,906 ft. The sands were several feet higher in No. 3.

Another offset, 2 Heletz, is located 1,300 ft. south and slightly west of No. 1. It had mechanical difficulty recently but is now drilling ahead. Before the trouble, the well had reached the top of the producing section several feet deeper than in the discovery.

As yet, water has not been encountered in any of the wells.

The tests are located less than 6 miles from the Gaza strip on a 75,000-acre license held by Lapidoth Israel Oil Co., Ltd., and Israel Oil Prospectors, Ltd. *(The Oil and Gas Journal, March 12, page 98.)*

The Heletz production is the only oil yet found in Israel, a country which relies solely on imports for all fuel needs. But the strike last September has spurred exploration anew. Seven rigs are now operating and 15 may be in the field this summer. Foreign capital, chiefly American and Canadian, is bankrolling the search.

New Depth Record Set in Asia

ASSAM OIL CO., LTD., has set a new drilling-depth record for Asia with its wildcat at Naoholia in Northeast India.

The test drilled below 12,666 ft., the depth at which the Burmah Oil Co., Ltd., I Lakhra, the former record holder, was abandoned in West Pakistan.

The Naoholia well is the first in Assam Oil's Hugrijan prospecting license area, located near Nahorkatiya field in Upper Assam Valley, where eight producing wells and three dry holes have been drilled since 1953. There have been signs of fluorescence from sandstone rocks in the new test. MicroLog and section gage surveys are being run.

Assam has selected four more drill sites in Upper Assam Valley. Three wells will be step-outs from the 3-year-old Nahorkatiya field, and one will be the second wildcat on the Hugrijan prospecting license. Two wells are drilling at Nahorkatiya. Output from Nahorkatiya and the older Digboi field now totals about 8,000 bbl. daily.

The new depth record was set amid a background of hassling over formation of a joint company by Assam Oil and the Indian Government to handle operations in the Nahorkatiya area.

At issue is which one will control the proposed rupee company. Formation of a joint firm by March 31 was one of the terms of two concession grants which Assam Oil obtained last August.

Under these terms, the government was to contribute one-third of the capital for operations in the 165-sq. mile Moran license, and the 280-sq. mile Hugrijan license in Assam. A 1954 agreement provided for the government to have 25 per cent interest in two Nahorkatiya licenses covering about 64 sq. miles.

Now the company wants an over-all agreement to cover all four of the concessions. It proposes a joint company for exploration and production in the area and for refining the output. A 20,000-bbl. daily refinery would be built at Calcutta. The government would have one-third interest in the company.

But, according to New Delhi reports, the government now wants 51 per cent interest in the new company. Dispute over this point is holding up a settlement.

Border Tiff Looms

Sahara discovery evokes Algeria-Libya discussion

THE recent French-Shell discovery deep in the Sahara Desert may not only open the world's newest oil province, it could also touch off the newest boundary dispute.

The well drilled by Cie. de Recherches et D' Exploitation de Petrole Au Sahara (C.R.E.P.S.) is less than 3 km. from the roughly defined border between Algeria and Libya. Reports from Algeria indicate the well has tested about 300 bbl. of oil daily from shallow carboniferous formations *(The Oil and Gas Journal, February 13, page 95)*.

Reports from North Africa last week indicated that the discovery has prompted what have been described as "still informal" talks between the two governments about the exact location of the boundary. Immediately opposite the C.R.E.P.S. well on the Libyan side of the border, Esso Standard of Libya, Inc. (Jersey Standard), and Libyan American Oil Co. (Texas Gulf Producing Co.), have large blocks of acreage recently granted by Libya.

Royal Dutch-Shell owns 35 per cent of C.R.E.P.S. The remainder is French controlled. The company has a concession of more than 100,000 acres in the area between the Libyan border and the French Foreign Legion post, Fort Flatters.

Trans-Siberia Pipeline Seen

Russia plans to extend its oil pipeline system all the way across Siberia to the Maritime territories during the 1960's.

N. K. Baibakov, formerly minister of the oil industry and now chairman of the USSR's State Financing Committee, revealed the project in a speech before the recent Twentieth Communist Party Congress in Moscow.

First section of the line, from the Tuimaza fields west of the Ural Mountains to Omsk, is now finished. The Omsk-Irkutsk link is to be built under the Sixth Five Year Plan (1956-1960), and the next eastward extension to the upper Amur River valley will be laid during the Seventh Five Year Plan (1961-1965). Final section will be to the industrial center of Khabarovsk, north of Vladivostock.

Total length of the line will exceed 4,000 miles. Baibakov said that if the new pipeline was not built, the USSR would have to construct an entire new trans-Siberian railroad just to handle petroleum products.

A SPECIAL FEATURE OF OIL AND GAS JOURNAL

Annual REFINING Section

100 OCTANE

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  As answered by the Journal's refining editor
- **Top Octanes From Heavy Crude**
  As obtained in Union Oil Co.'s California refineries

MODEL IV
Catalytic Cracking

FLUID catalytic cracking accounts for 70 per cent of the total installed catalytic cracking capacity in the United States. It accounts for 78 per cent abroad.

A continuous process, fluid cat cracking gives excellent yields of high-octane gasoline. It also gives excellent yields of important byproducts such as isobutane and light olefins for alkylation, polymerization, L.P.G., or synthetic rubber. Its inherent flexibility enables the refiner to meet changing market demands.

Improvements . . . Improved features have resulted in substantially lower investment and operating costs. Improvements include: simpler, more compact design; simplified catalyst recovery; more compact catalyst circulation systems; smaller vessels sizes; and improved mechanical and plant layout features. The Model IV requires only one-third of the steel used in original designs.

Catalyst flow . . . The process is based on the circulation of finely divided catalyst suspended in gas or vapor. Flowing much like a liquid, the catalyst circulates continuously between the reactor and regenerator. Oil is fed continuously to the reactor where cracking occurs. The catalyst becomes fouled with carbon during the reaction. In the regenerator, the hot catalyst is contacted with air which burns off the carbon. By flowing continuously, the catalyst acts as a heat-transfer medium between the regenerator where heat is liberated and the reactor where heat is absorbed by the reaction. Temperature is controlled by the regulation of catalyst rate.

Feed is injected into the hot regenerated catalyst line just before it enters the reactor.

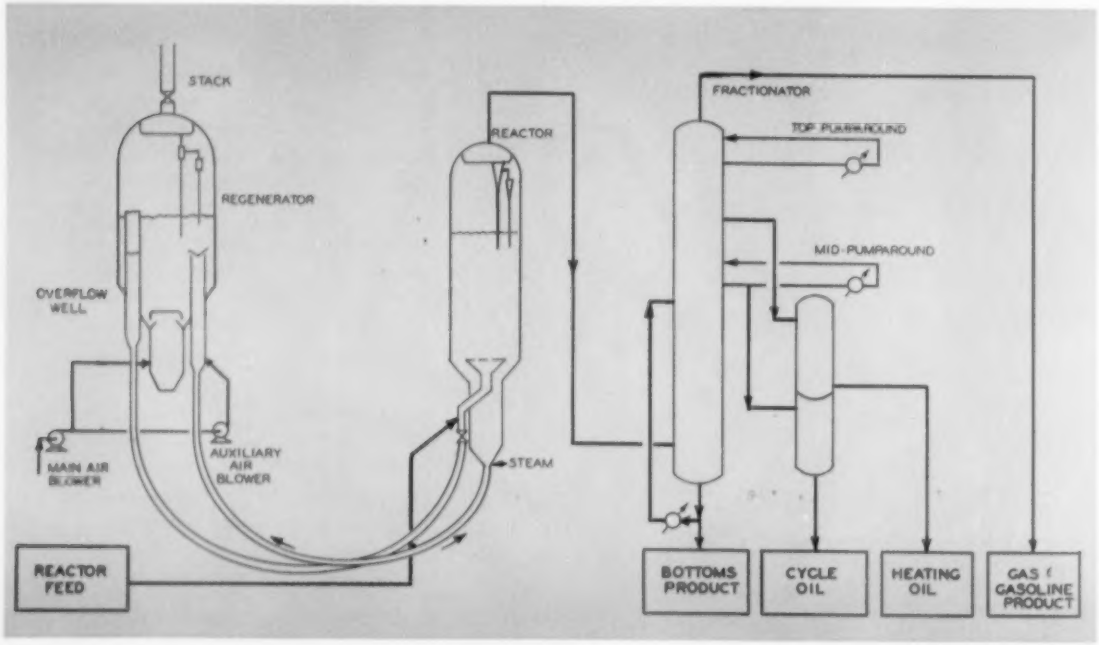
Products . . . Products are removed in vapor form through cyclone separators which return most entrained catalyst to the bed. Cracked products are then separated in conventional fractionation and absorption equipment.

Thirty-one Model IV catalytic cracking units with a total capacity of 560,000 bbl. per day have been built or ordered to date, and more are under consideration. Thirteen of these units have been licensed to refiners outside the Jersey circuit. Installed Model IV units range in capacity from 4,900 to 55,000 bbl. per day total feed.

Typical yields from Model IV fluid catalytic cracking, recycle operation, would be as follows:

	23.3° A.P.I. Colombian gas oil	32.8° A.P.I. paraffinic Sumatra gas oil
Conversion, volume per cent fresh feed	78.8	72.0
Yields:		
Debutanized gasoline, vol. % F.F.	58.9	53.7
Light cycle gas oil, vol. % F.F.	18.2	25.2
Heavy cycle gas oil, vol. % F.F.	3.0	2.8
Butylenes, vol. % F.F.	9.6	10.5
Butanes, vol. % F.F.	7.4	8.4
Propylene, vol. % F.F.	8.5	6.8
Propane, vol. % F.F.	3.1	2.6
C_2 and lighter gas, wt. % F.F.	3.7	2.8
Coke, wt. % F.F.	8.6	4.8
Inspections:		
Fresh feed:		
20% at °F.	675	700
50% at °F.	835	795
80% at °F.	990	900
Debutanized cat gasoline:		
C.F.R.R. clear	94.4	92.5
R.v.p.	6.4	5.8
With polymerization:		
Yield, total 10-lb. R.v.p. gasoline, vol. % F.F.	75.4	70.1
C.F.R.R. clear, 10-lb. R.v.p. gasoline, vol. % F.F.	95.9	94.4

The Model IV catalytic cracking process is licensed by Esso Research & Engineering Co., New York.



ORTHOFLOW
Fluid Catalytic Cracking

STRAIGHT-LINE fluid catalytic cracking, in which reactor and regenerator are combined in a single vertical structure, was developed for the production of high-octane gasoline at low investment cost.

This Orthoflow design, developed and licensed by M. W. Kellogg Co., provides straight-line flow of catalyst between the vessels, thereby reducing catalytic erosion.

Two modifications of the design have been developed and proved in commercial installations: Model A with the reactor positioned atop the regenerator, which is operated at about 8 psig. above reactor pressure to afford proper balance; and Model B, in which the positions of reactor and regenerator are reversed.

Model B . . . In the improved Model B design, the pressure differential between reactor and regenerator is reversed, considerably reducing utilities requirements and operating costs. In effect, this design raises the suction pressure of the compressor handling reactor gas, and lowers the discharge pressure of the blower furnishing combustion air to the regenerator. The sizes of the reactor and fractionator are also reduced in this design.

At present 17 units of the Orthoflow design are operating or under construction—6 Model A units with a total throughput capacity of 46,500 bbl. per day, and 11 Model B units with a capacity of 310,000 bbl. per day.

Operating features . . . The accompanying diagram illustrates the schematic flow of a typical Model B Orthoflow catalytic cracker. Preheated fresh feed combines with recycle gas oil from the fractionator and flows to the Orthoflow converter.

Catalyst and oil vapors are delivered to the bottom of the reaction section. The fluidized-catalyst bed depth is controlled at a level providing sufficient contact time of catalyst with oil vapor to obtain desired conversion. Above the fluidized bed, a disengaging space is provided for separation of the powdered catalyst from the cracked vapors. The vapors then pass out of the reactor through single-stage cyclones where any catalyst carried through the disengaging space is recovered and returned to the reactor bed.

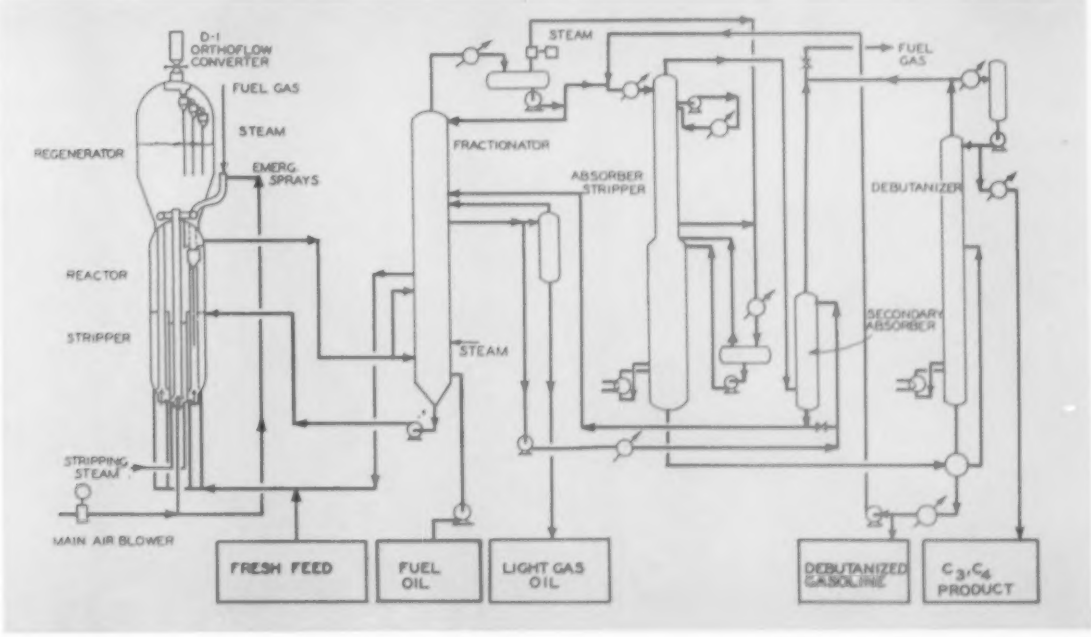
Spent catalyst is withdrawn from the reactor bed and fed to the stripper through openings in the partition between the two sections. Steam and stripped vapors are vented through the open top of the stripper section into the disengaging space above the reactor bed.

Stripped spent catalyst flows from the bottom of the stripper through a plug valve, and air is introduced through the hollow stem of the plug valve to convey the catalyst upward into the regenerator. The spent-catalyst plug valve provides direct control of the level of the catalyst bed in the reactor-stripper section.

M. W. Kellogg Co. also licenses, designs and constructs fluid catalytic cracking units of the side-by-side type of design.

TYPICAL YIELDS FROM MODEL B ORTHOFLOW CAT CRACKER

Fresh feed, mixed gas oil, bbl. per day	7,400
Gravity, °A.P.I.	33.0
Throughput ratio	1.7
Conversion, volume per cent	86.0
Tail gas, volume per cent (F.O.E.)	4.0
C_3 and C_4 to poly, volume per cent	34.5
Debutanized gasoline, volume per cent	54.0
Light cycle oil (No. 2 fuel), volume per cent	7.3
Debutanized gasoline:	
Gravity, °A.P.I.	58.0
R.v.p., psi.	7.6
50 per cent point, °F.	200
End point, °F.	430
C.F.R.-R. clear	92.0
C.F.R.-R. + 3 cc.	98.5



THERMOFOR Catalytic Cracking

THE Thermofor Catalytic Cracking (T.C.C.) process was developed in the Socony Mobil Laboratories, and the first commercial unit began operation in 1943. Later the design was modified to replace the bucket elevators of the catalyst-circulation section with an Airlift.

The first Socony Airlift T.C.C. was placed on stream in 1950, and was described in the June 28, 1950, issue of The Oil and Gas Journal. At the present time there are 44 Airlift T.C.C. units in operation; 26 in the United States, and 18 in foreign countries. Six additional units are under construction or are authorized.

The various units cover a wide range of capacities, the smaller ones having design feed rates of about 1,600 bbl. per day and the larger 28,000 bbl. per day. Respective carbon burning capacities are 1,100 lb. per hour and 29,000 lb. per hour. The total throughput capacity of the 50 Socony Airlift T.C.C. units in operation, under construction and authorized, is well over 600,000 bbl. per day. Including elevator units, the total capacity of the T.C.C. units in operation is over 1,000,000 bbl. per day.

Increases of up to 50 per cent in reactor capacity and 40 per cent in kiln capacity have been realized through modification of existing Socony Airlift T.C.C. units at very little expense.

The feed to operating units ranges from the entire crude to very heavy gas oil fractions.

Top charge . . . Where previously prepared gas-oil charge stock is available a method of injecting the entire charge directly into the top of the catalyst bed has been adopted, thus eliminating the tar separator.

Some refineries choose to visbreak or coke the residuum fraction, and then charge the cracked gas oils alone or in conjunction with virgin stock to the T.C.C. unit. Others have found it advantageous to supplement the feed with straightrun naphthas in order to obtain an octane number improvement and partial desulfurization. Commercial data on some of the different charge stocks are shown in Table 1. Typical data from 12 Socony operated units show an average gasoline yield of 47 per cent at a conversion of 65.4 per cent.

The simplicity of the T.C.C. process is reflected in low installation and operating costs. While natural clay catalyst may be used for these units, a synthetic bead catalyst is generally preferred and the excellent properties of this material help to maintain low unit operating expenses. The synthetic catalyst is unusually stable and, therefore, maintains a high level of equilibrium activity. The structure and strength of the bead resist attrition. Catalyst consumption data for the 31 units on which long-term data are available show an average usage of 0.27 lb. per barrel of feed.

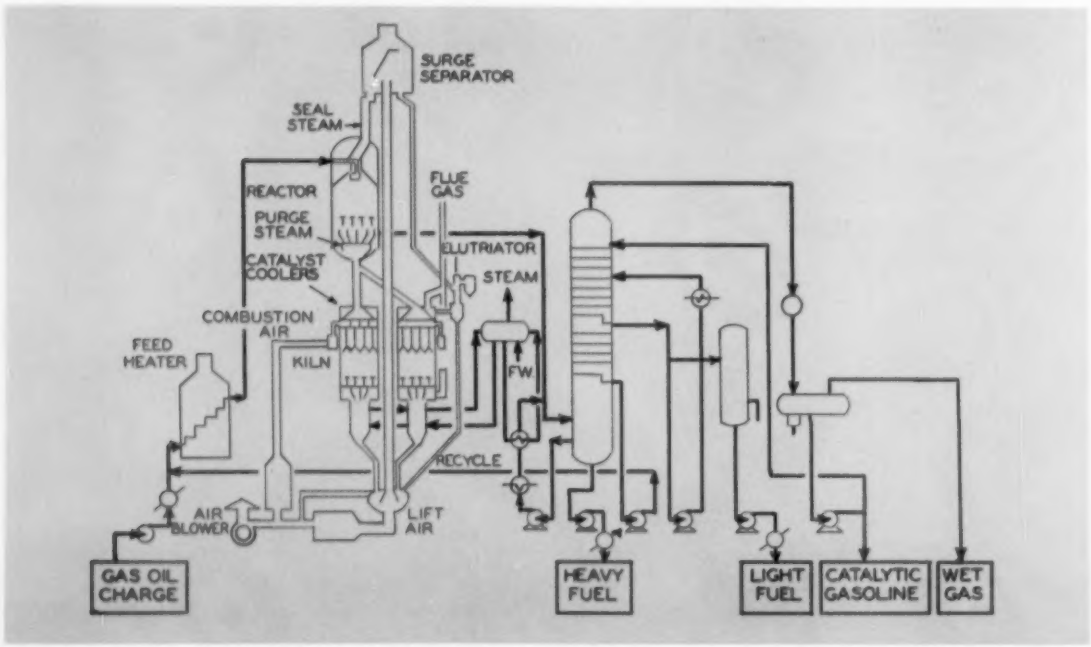
Table 2 gives an analysis of these data by unit type.

TABLE 1—SOCONY AIRLIFT T.C.C. COMMERCIAL YIELDS

Charge stock—	Venezuela gas oil	Mid-Cont. gas oil	50% M.C. gas oil, 50% cracked gas oil	65% Mid-East gas oil, 35% str. naphtha	Canadian gas oil
Approx. boiling range	500-950	400-850			
Fresh feed, B/D	11,757	9,557	10,128	6,457	10,264
Recycle, B/D	2,878	1,015	5,538	2,614	5,346
Gasoline yield, vol. %	42.8	38.0	51.0	54.5	54.5
Oct. No. research with 3 cc. lead	97.0	99.1	95.7	93.8	98.2

TABLE 2—CATALYST CONSUMPTION ON VARIOUS SIZE SOCONY AIRLIFT T.C.C. UNITS

Number of units averaged	4	4	8	15
Reactor charge, bbl./day	4,000	6,600	9,800	17,000
Catalyst circulation rate, T/hr.	92	160	235	380
Catalyst consumption, T/day	0.6	1.0	1.2	2.3
Catalyst used/reactor charge, lb./bbl.	0.30	0.30	0.25	0.27



U.O.P. Fluid Catalytic Cracking

THE U.O.P. fluid catalytic cracking process is a modern, highly developed method of producing high-octane gasolines from a large variety of gas wells. The fluid principle gives intimate contact between charge and catalyst in the reactor, and optimum regeneration conditions in the regenerator. The energy required for catalyst circulation is furnished by vaporizing the charge by direct contact with the hot, regenerated catalyst and maintaining a reactor pressure lower than in the regenerator.

An important feature of the process is its ability to crack a large variety of charge stocks from all types of crude oils. Boiling range of the charge is nonlimiting. Typical stocks which can be efficiently processed include naphtha, kerosine, light gas oil, distillate, atmospheric and vacuum heavy gas oils, and distillates from viscosity breaking or coking. High-sulfur feeds containing large amounts of nitrogen may be successfully processed without operating penalties. Desalted crude is fed directly to the process in several installations. Because the charge is heated by direct contact with regenerated catalyst a heavy distillate charge which would rapidly coke up a feed preheater may be handled without difficulty.

The accompanying flow diagram is for a typical 5,000-bbl. per stream day unit of the heat-balance type, which eliminates feed preheaters and catalyst coolers and permits generating of much of the steam required in process and as power for prime movers.

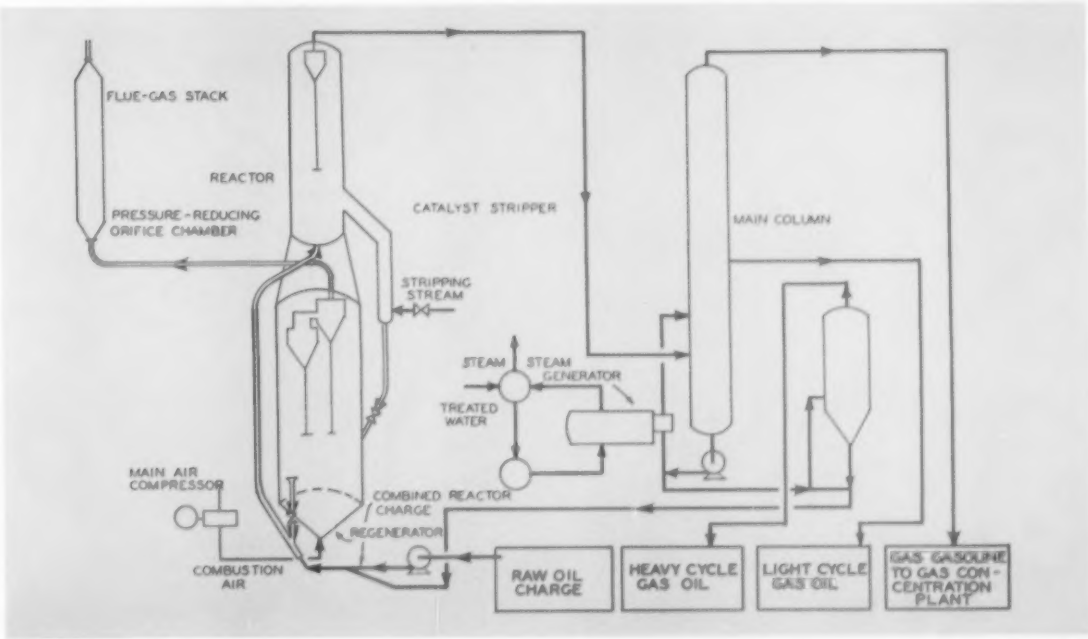
Typical yields from a U.O.P. fluid catalytic cracking unit charging a 31° A.P.I. Mid-Continent gas oil over a silica-alumina catalyst, are shown in Table 1 for once-through and recycle operation. At the present time there are about 65 catalytic cracking units designed by U.O.P. in operation or under construction. They represent a total design feed capacity of over 450,000 bbl. per day.

TABLE 1—TYPICAL YIELDS

Operation—	Once-through	Recycle
Conversion, vol. per cent gas oil disappearance	60	75
Yields (vol. per cent):		
Debutanized gasoline	45.0	53.0
Cycle stocks	40.0	25.0
Butylenes	5.8	7.1
Butanes	8.7	9.4
Propylene	5.2	6.4
Propane	2.4	3.3
C_2 and lighter, wt. per cent	2.5	3.1
Octanes, 10-lb. R.v.p. gasoline:		
Motor method, clear	81.8	81.8
With 3 ml. TEL	86.8	87.4
Research method clear	93.7	94.2
With 3 ml. TEL	98.7	99.1
Yields with polymerization, vol. per cent:		
10-lb. R.v.p. polymer gasoline	8.0	9.9
10-lb. R.v.p. catalytic gasoline	47.7	55.8
Total 10-lb. R.v.p. gasoline	55.4	65.7

TABLE 2—YIELDS, OKLAHOMA GAS-OIL CHARGE

Conversion, vol. per cent gas-oil disappearance	70
Yields, vol. per cent:	
Debutanized gasoline	50.5
Light cycle oil	25.0
Heavy cycle oil	5.0
Butylenes	6.0
Isobutane	5.2
n-Butane	1.7
Propane, propylene, ethane, ethylene, total weight per cent	7.8
Combined feed ratio, by volume	1.66
Catalyst-to-oil ratio:	
On raw oil	19.1
On combined feed	11.3
Weight hourly space velocity:	
On raw oil	6.2
On combined feed	9.5



HOUDRIFLOW
Catalytic Cracking

"Reactor feed may be all liquid, all vapor, or a mixture of both. Except for 1 of the 19 Houdriflow units, the charge is well above 50 per cent liquid."

HIGH yields of motor gasolines with octane values in the 88-94 F-1 clear range (95-99 with 3 cc. TEL) are produced by Houdriflow catalytic cracking, depending on charge stock, temperature, and catalyst used in the individual unit operation.

Conversion above 90 per cent has been achieved in some units with relatively low coke deposit, using recycle ratios of 1 to 1 or slightly more. Where once-through cracking is preferred, 50 to 60 per cent conversion is obtained.

Petroleum distillate stocks of wide variety are being catalytically cracked in Houdriflow operations. Sweet and sour stocks are handled with equal ease, as well as any fraction from the crude boiling between naphtha and penetration asphalt.

Reactor feed may be all liquid, all vapor, or a mixture of both. Except for 1 of the 19 Houdriflow units, the charge is well above 50 per cent liquid. In some cases the feed is totally liquid phase, and may consist completely of accumulated cycle stock.

The Houdriflow process is distinguished for ease of operation under normal and emergency operating conditions, low maintenance and operating cost, high catalyst activity in conjunction with low catalyst make-up cost, and flexibility as to charge stocks handled and conversion levels attained. Synthetic or natural catalyst may be employed.

This efficient continuous moving-bed process may be arranged compactly on a ground area approximately 40 by 60 ft. The integrated catalytic reactor and regenerating kiln—a single vessel—and the hot catalyst storage vessel are self-supporting, and generally are located on opposite sides of a steel structure housing a stairway and supporting the catalyst lift and elutriator. Regenerated catalyst is recirculated by a pneumatic lift system.

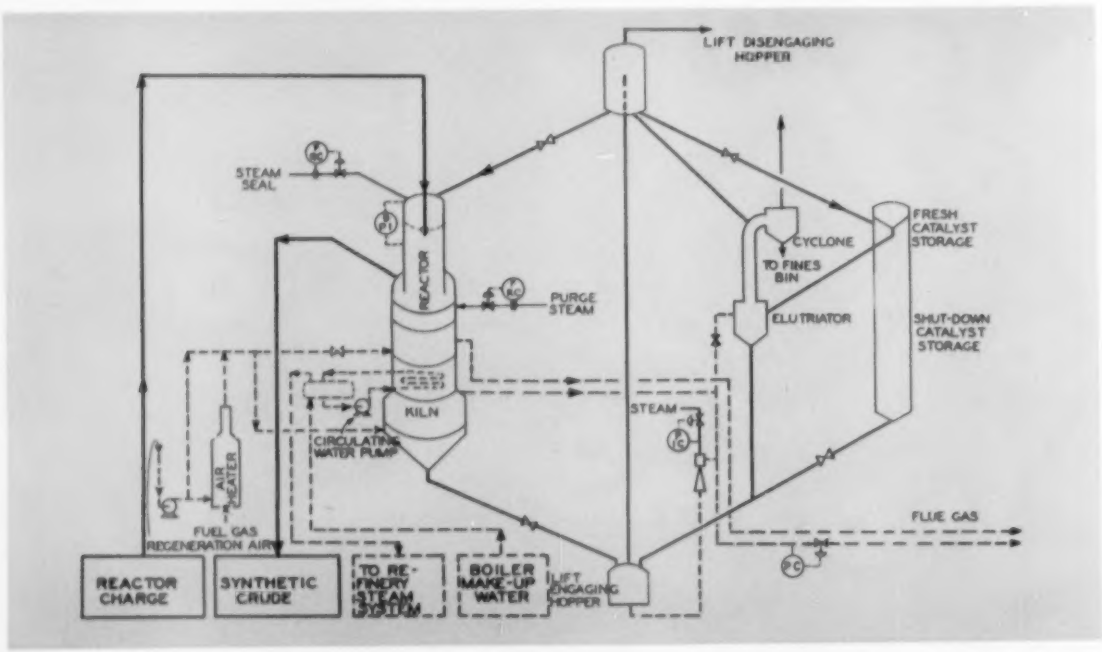
Normal operating conditions fall within these ranges: temperature 850°-925° F.; pressure 9-10 psig.; space velocity 1.5-4 v./hr./v.; and catalyst-oil ratio 3.7.

Nineteen units, with total nominal design capacity of 240,000 bbl. per stream day, are in operation.

TABLE 1—TYPICAL HOUDRIFLOW YIELDS WITH FEEDS OF VARIOUS COMPOSITION

Charge:*	A	B	C
Virgin gas oil	5,810	4,460	4,750
First pass cat. gas oil	1,430		
Recycle		2,200	5,700
Total charge, bbl. per day	7,240	6,660	10,450
Products:			
Gasoline, 10 lb., 380/90, volume per cent	40.8	53.7	67.8
Total gas oil, volume per cent	50.3	31.1	9.2
C_3-C_4 recovered, volume per cent	16.1	18.6	25.0
Liquid recovery, volume per cent	107.2	103.4	102.0
Fuel gas, weight per cent	3.8	5.8	7.3
Catalyst deposit, weight per cent	5.2	5.4	9.0
Gasoline octanes:			
F-1 Clear	91.5	90.6	89.3
F-1 + 3 cc. TEL			96.7
F-2 Clear	81.7		

*Charge stocks are atmospheric plus vacuum gas oils from: (A) Texas pipeline crude, (B) Scurry crude, and (C) Hutchinson-Moore County, West Texas, crude.



HOUDRESID
Catalytic Cracking

HOUDRESID catalytic cracking is a refinery-proved continuous moving-bed process by which exceptional yields of high-octane gasoline and light distillate fuels are obtained from reduced crude. Octane values of the gasoline product are in the range of 90-95 F-1 clear, and heavy residual fuel is eliminated by the Houdresid process.

Novel process features prevent the adverse effects on product selectivity heretofore resulting when heavy metals are present in the feed. In addition, residua high in sulfur and nitrogen may be charged. Residuum cuts ranging from atmospheric tower bottoms to vacuum bottoms may be charged to the Houdresid unit, thereby permitting refiners greater flexibility in the kind of crude that may be run. If desired, the entire crude may be charged.

Both natural and synthetic catalysts may be used, and it has been demonstrated that an inexpensive natural catalyst is particularly well suited to Houdresid processing. In commercial operation, catalyst attrition has averaged only 0.4-0.5 lb. of catalyst per barrel of reactor charge, indicating no necessity for withdrawal of catalyst, over requirements from normal mechanical loss, in order to maintain selectivity and activity.

In commercial operation charging reduced crude from mixed Mid-Continent, Texas, and Louisiana crudes, conversion ranged from 65 to 70 volume per cent, depending on changes in throughput, recycle ratio, space rate, catalyst-oil ratio, and temperature. C_5+ gasoline yields varied from 48 to 53 volume per cent, and coke (as deposit on catalyst) between 5.9 and 8.2 weight per cent.

The Houdresid process also provides a greater potential polymer gasoline yield from polymerization of C_3 and C_4 cuts for blending into final high-octane product, as well as favorable proportions of No. 2 domestic fuel oil.

HOUDRESID UNITS

Nom. des. cap. (B/D)	Company	Location	Status
11,500	Sun Oil Co.	Sarnia, Ont.	On str. 1953
*24,000	Sun Oil Co.	Toledo	On str. 1955
*27,000	Sun Oil Co.	Marcus Hook, Pa.	On str. 1955

*Houdriflow units designed for Houdresid processing.

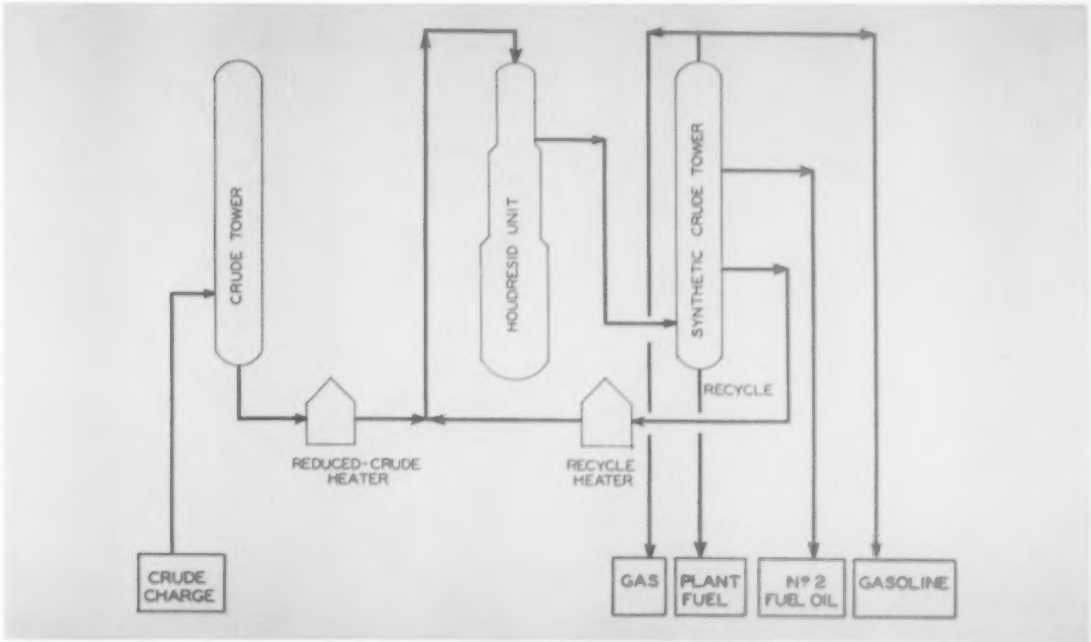
HOUDRESID PROCESSING OF MIXED MID-CONTINENT, TEXAS AND LOUISIANA CRUDES

Charge to Houdresid unit (B.P.S.D.)	7,364	10,009
Reduced crude	(5,020)	(6,410)
Recycle	(2,344)	(3,599)
Inspection of charge:		
Gravity, °A.P.I.	26.9	
Sulfur, weight per cent	0.47	
Yields (based on fresh feed):		
Conversion, volume per cent	67.6	67.6
Debutanized gasoline, volume per cent	48.5	51.6
C_4 cut, volume per cent	14.8	13.1
Dry gas, weight per cent	10.3	7.9
Coke, weight per cent	7.1	5.9
Hydrogen, s.c.f./bbl. residuum converted	129	138
Inspection of C_5+ gasoline:		
Octane, F-1 clear	93.0	91.6
Sulfur, weight per cent	0.08	0.08

HOUDRESID PROCESSING OF HEAVY RESIDUA

Charge stock—	10%†	10.6%*	4.1%*
Gravity, °A.P.I.	12.6	17.7	12.7
Sulfur, weight per cent	0.91	0.72	1.02
Yields, per cent of fresh feed	Once-through	Once-through	Once-through
Debut. gaso., vol. per cent	40.1	42.6	40.4
Cat. gas oil, vol. per cent	40.2	37.0	27.1
C_4's, vol. per cent	10.4	13.1	15.6
Dry gas, wt. per cent	7.3	11.6	13.5
Coke, wt. per cent	16.3	8.5	17.6
Inspections of C_5+ gasoline:			
F-1 clear octane	89.3	93.4	90.7

*South Central Texas mixed reduced crude. †Mixed Mid-Continent, Texas and Louisiana reduced crude.



HOUDRIFORMING
Catalytic Reforming

HOUDRIFORMING is a fixed-bed catalytic reforming process utilizing a platinum-content catalyst to convert straightrun and cracked petroleum naphthas to aviation blending stocks, aromatics, and motor gasoline in the 80-100 F-1 clear octane range, depending upon feed-stock composition and type or severity of operation.

Total licensed Houdriforming capacity amounts to 129,310 bbl. per day. Eight Houdriforming units are now on stream with a nominal design capacity of 60,060 bbl. per day, and eight additional Houdriformers with a capacity of 69,250 bbl. per day are under construction or in the engineering stage. One of the latter has a design capacity of 45,000 bbl. per stream day.

At moderate severities, Houdriforming may be operated for either high-octane motor fuel or aromatics in a truly continuous manner, without need for regeneration of catalyst. However, the process lends itself readily to in-place catalyst regeneration, as has been commercially demonstrated, although this is required only for operation at high severity.

The Houdry Type 3 catalyst used in Houdriforming fulfills exacting requirements for strength, activity, and selectivity, and is well balanced to carry out the reactions involved — dehydrogenation, aromatization, isomerization, hydrocracking, and desulfurization.

A wide variety of charging stocks, differing substantially in chemical composition and boiling range, may be charged to Houdriforming units, including naphthas with end boiling points up to 400° F. With Houdriforming, it is possible to upgrade low-octane straightrun naphthas by as many as 40 to 70 octane numbers, with impressively high liquid volume recovery. Stabilized reformates require no further treatment.

HOUDRIFORMING: TYPICAL OPERATING CONDITIONS

Temperature, °F.	875-950
Pressure, psig.	250-600
Space velocity, v./hour/v.	1.5-5.0
Hydrogen—oil mole ratio	4-10

PROCESSING 230°-394° F. PARAFFINIC NAPHTHA FROM NATURAL-GAS CONDENSATE

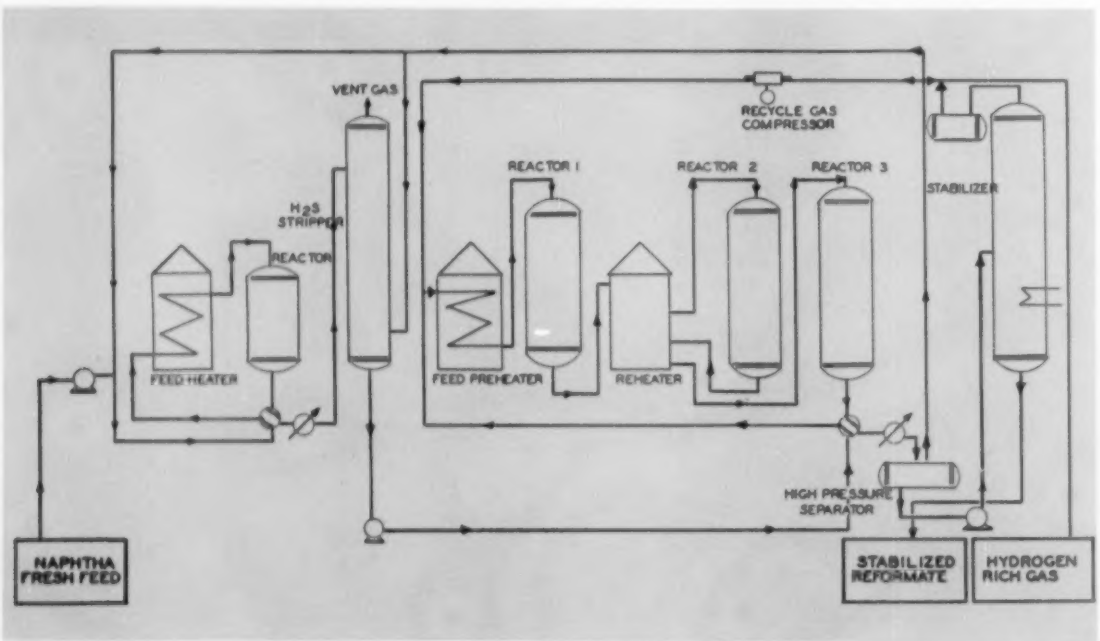
	A		B	
Yields:	Wt. %	Vol. %	Wt. %	Vol. %
Debutanized gasoline	80.1	78.1	83.2	80.8
Stabilized gasoline (10-lb. R.v.p.)		86.7		89.5
Excess C_4		1.3		0.5
Inspections—	Fresh charge	Debut. prod.	Stab. prod.*	Debut. prod.
Gravity, °A.P.I.	58.8	54.0		53.2
Sulfur	0.003	Nil		Nil
R.v.p.		2.7	10	3.0
Octanes:				
F-1 clear	24.6	82.3	83.1	80.1
+3 cc. TEL	55.4	93.3	94.8	93.0

*Tests on product after adding C_4 for 10-lb. R.v.p.

HOUDRIFORMING OPERATIONS FOR MOTOR GASOLINE PRODUCTS

	Low paraffin content naphtha from mixed naphthenic crudes		Intermediate paraffin content naphtha from East Texas crude		High paraffin content naphtha from Kuwait crude	
Charge stock—						
Gravity, °A.P.I.	45.8		55.3		52.9	
F-1 clear octane	61.3		55.6		23.5	
Sulfur, wt. per cent	0.012		0.006		0.10	
Houdriforming data—	Operation					
	Mild	Severe	Mild	Severe	Mild	Severe
Yields, based on charge:						
Debutanized reformate, vol. per cent	88.3	80.6	91.0	83.5	87.4	80.4
Debut. reformate:						
F-1 clear oct.	92.0	*101.0	80.0	92.0	76.8	90.0
F-1 +3 cc. TEL	99.2	*104.2	92.5	99.5	91.0	98.3
Gravity, °A.P.I.	39.7	36.5	52.7	45.8	50.7	47.7
Sulfur, wt. per cent	0.002	0.002	<0.001	0.002	<0.001	<0.001

*Octanes above 100 are extrapolated by method of Deters, J. F., Pet. Ref., Vol. 30, No. 6 (June 1951).



PLATFORMING U.O.P.

THE U.O.P. Platforming process is the first catalytic reforming method to successfully employ a platinum-containing catalyst to produce high-octane-number motor fuels or aviation-gasoline components from refinery naphthas of much lower octane number. The process also will produce high yields of aromatic concentrates from select naphtha cuts for subsequent recovery. Two improved catalysts have recently become available which are specifically tailored for use in the production of 98 and higher leaded research octane-number gasolines.

Platforming has been extensively employed for improving octane number since the first commercial unit went on stream in a Michigan refinery over 6 years ago. It also is extensively used for the production of benzene, toluene, xylenes, and heavier aromatics from refinery stocks.

Platforming is carried out at temperatures ranging from 850° to 1,000° F. and pressures of 200 to 700 psi. In general, the lower ranges of pressure are used for production of aromatics, while intermediate and higher pressures are employed for octane improvement.

Six principal reactions occur simultaneously during Platforming, including: (1) dehydrogenation of C_6 ring naphthenes; (2) isomerization of other naphthenes and their dehydrogenation to aromatics; (3) dehydrocyclization of paraffins; (4) hydrocracking; (5) isomerization of paraffins, and (6) desulfurization.

The accompanying flow diagram illustrates typical equipment and arrangement to Platform naphtha in the production of high-octane motor fuel. The charge stock is prefractionated (not shown) to remove the lower-boiling hydrocarbons which need the least improvement octanewise from Platforming. When operated for maximum aromatics production, a cut is charged containing the C_6 to C_9 fraction, or a wider range if heavier aromatics are desired also. For an aviation-gasoline blending stock the Platformate may be rerun in addition to being stabilized. For aromatics recovery, it is suggested that the Platformate be charged to a Udex unit.

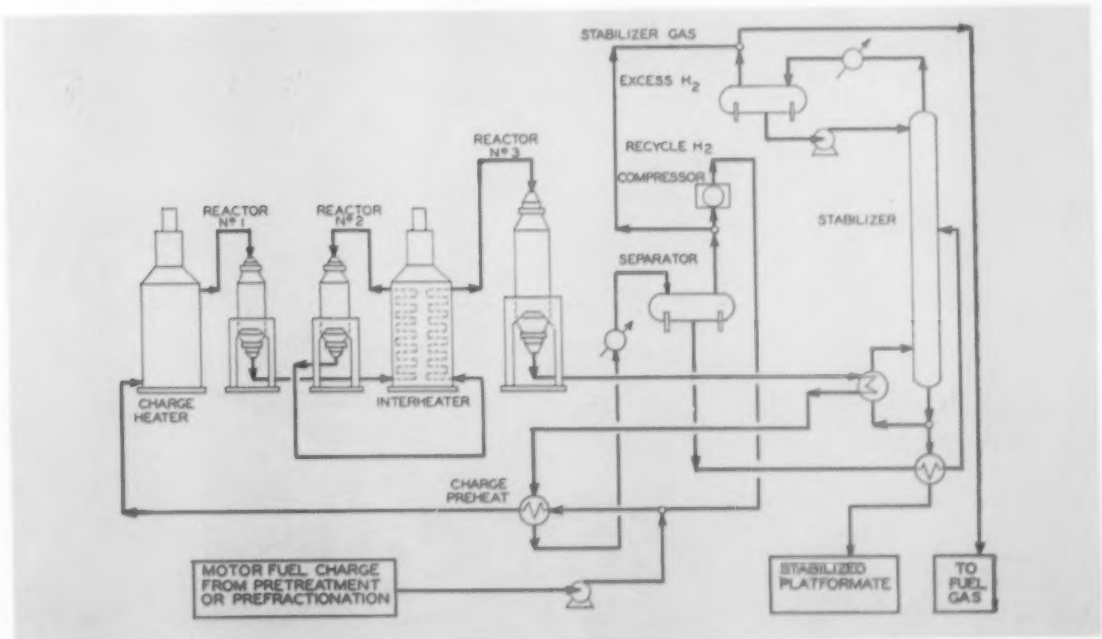
The data shown were obtained on a commercial unit which was operated at high severity conditions to produce a leaded octane number product of approximately 100 research. Inspections of a typical charge stock and Platformate are shown in the table. Indicative of the severity of reforming is the jump to 93.0 clear octane research for the Platformate as compared to 48.0 for the charge stock.

During the test the average octane number was maintained at substantially 100 over a catalyst age increment of 35 bbl. per pound of catalyst. During this time the average reactor inlet temperature was increased about 25° F. Charge rate was essentially constant. The average yield of Platformate was over 81 volume per cent, based on reactor charge.

This process is licensed by Universal Oil Products Co.

PLATFORMING AT HIGH SEVERITY

	Charge	Platformate
Gravity, °A.P.I.	55.0	49.0
PONA analysis, volume per cent:		
Paraffins	40	...
Olefins	Trace	...
Naphthenes	52	...
Aromatics	8	...
A.S.T.M. distillation, °F.:		
I.b.p.	200	110
10 per cent	222	154
20 per cent	235	180
50 per cent	265	245
90 per cent	332	336
E.p.	384	419
Total sulfur, weight per cent	0.012	Nil
Reid vapor pressure, psi.	...	4.8
Research octane ratings:		
Clear	48.0	93.0
With 3 ml. TEL	...	100.3



ISO-PLUS HOUDRIFORMING

ISO-PLUS Houdriforming combines conventional catalytic Houdriforming with either aromatics separation or thermal reforming to transform low-octane naphthas into gasoline in the range of 100 octane, F-1 clear, at high yield levels.

Experimental runs of Iso-Plus aromatics extraction variations have resulted in yields of 100-octane gasoline, F-1 clear, of up to 91 per cent of naphtha charge. One of these schemes, with slight operational modification, yields 82 volume per cent of charge as 108-octane, F-1 clear, gasoline.

Pilot-plant and refinery Iso-Plus processing plus thermal reforming yields 80 to 90 per cent of reformed gasoline, depending upon the desired octane rating of the final product. This Iso-Plus route may be particularly attractive to refineries with available thermal reforming equipment.

A flow diagram for the three Iso-Plus routes are shown on these pages. Table 1 shows the properties

TABLE 1—INSPECTIONS OF REFORMER CHARGE

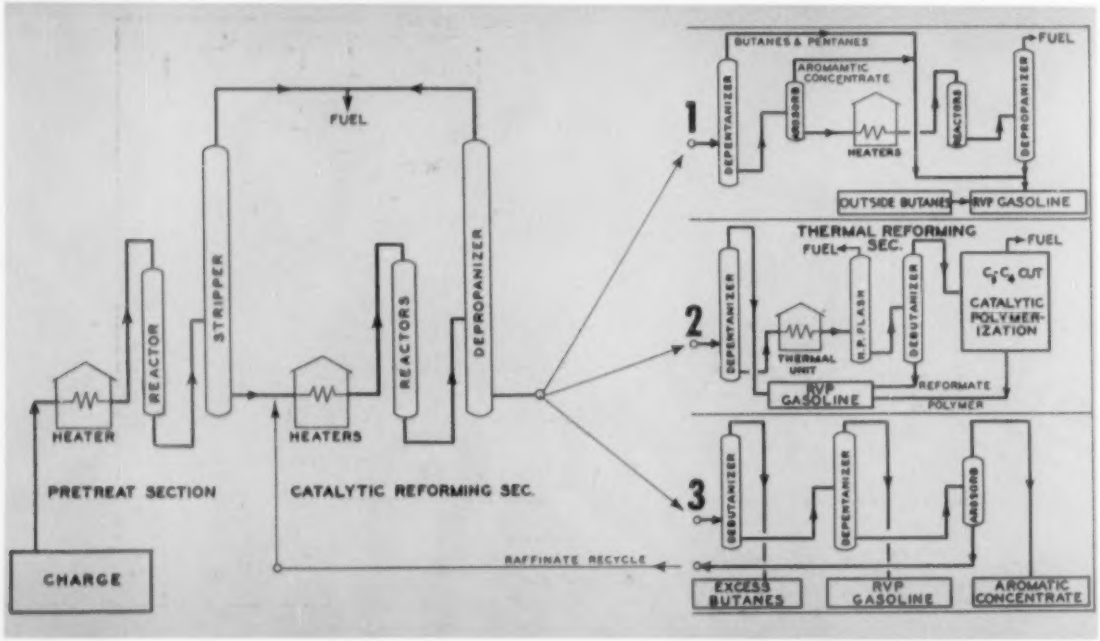
Gravity, °A.P.I.	51.0
Distillation, °F.:	
I.b.p.	200
10 per cent	230
50 per cent	295
90 per cent	365
End point	394
Sulfur, weight per cent	0.125
F-1 clear octane	54.1
Composition, volume per cent:	
Paraffins	46
Olefins	
Naphthenes	37
Aromatics	17

TABLE 2—COMPARATIVE YIELDS AND PROCESS STREAMS OF ISO-PLUS HOUDRIFORMING PROCESSES

	Houdriforming plus aromatics extraction		Houdriforming plus thermal reforming
Feed to pretreater (B/SD)	6,600	6,600	6,600
Recycle raffinate		3,531	
Total reformer feed	6,600	10,131	6,600
Yields from reforming:			
Reformate, C_5+	5,003	8,753	5,900
Butanes	271	574	271
Fuel gas, F.O.E.	422	818	422
Reformate octane, F-1 clear	87.0	83.0*	87.0
Charge to debutanizer		9,327	6,171
Charge to depentanizer	6,171	7,068	
Depentanizer bypass stream		1,685	
Arosorb charge	5,603	6,545	
Aromatic concentrate	3,174	3,014	
Raffinate	2,429	3,531	

Yields from second pass reforming:	Houdriform raffinate		Thermal reform reformate
Reformate, C_5+	1,932		4,807
Heavy polymer			33
Butanes	246		143
Butenes, recovered for cat. poly chg.			273
Propene, recovered for cat. poly chg.			183
Fuel gas, F.O.E.	293		491
Reformate octane, F-1 clear	81.0		99.6
Catalytic polymer gasoline			328
Over-all yields:			
Butane free gasoline	5,403	5,222	5,135
Butanes for 10-lb. R.v.p.	590	529	536
Total 10-lb. R.v.p. gasoline	5,993	5,751	5,671
Excess butanes	*73	45	*122
Fuel gas, F.O.E.	715	818	913
F-1 clear octane of 10-lb. R.v.p. gasoline	100.0	100.0	100.0

*Outside butanes required.



of a 200°-394° F. (A.S.T.M.) virgin naphtha from which yields via each Iso-Plus processing variation appears in Table 2. Table 3 shows pilot-plant yields for Iso-Plus thermal reforming of 84 and 89 F-1 clear reformates, and Table 4 gives data on refinery Iso-Plus thermal processing of an 80.5 F-1 clear catalytic reformate.

In each of the two Iso-Plus schemes employing aromatics extraction (Nos. 1 and 3), virgin naphtha feed is first charged to a Houdriformer pretreat section consisting of heater and catalytic guard case, and thence to a stripper tower. H_2S and other contaminants are vented from the stripper, and the main effluent moves to the Houdriformer's three heaters and catalytic reactors in series. Operating conditions for Houdriforming are moderate in all three Iso-Plus variations.

In one of the Iso-Plus schemes employing aromatics separation (No. 1), the 87 F-1 clear Houdriformer is flashed, and stabilized, with butanes and pentanes going to product. Depentanized effluent is charged to aromatics extraction, and a 91 per cent aromatics concentrate is separated as product.

An 81 per cent paraffinic raffinate is then moved to a second Houdriforming stage, yielding 81 F-1 clear Houdriformate for flashing and depropanizing. The final blend of 100-octane F-1 clear gasoline consists of the aromatic concentrate, butanes and pentanes from the first Houdriforming stage, and the stabilized Houdriformate from the second Houdriforming stage. (See Table 2 for yields.)

It is this Iso-Plus variation that may be slightly altered in operation to achieve even further increases in gasoline octane. Recycling the second-pass Houdriformate to aromatics extraction, thereby ultimately converting paraffins to 91 per cent aromatic concentrate, pentanes and lighter, makes it possible to recover more than 80 per cent of naphtha feed as 108 F-1 clear octane 10-lb. R.v.p. gasoline.

The second Iso-Plus aromatics separation route employs only one Houdriforming stage. The depentanized effluent in this case is an 83 F-1 clear Houdriformate. Most butanes and part of the debutanized reformate go to final product. The remainder of the depentanized Houdriformate undergoes aromatics extraction, with concentrate going to product and paraffinic raffinate recycling to the main feed stream to the Houdriforming section. Yields appear in Table 2.

The Iso-Plus thermal variation (No. 2) also pretreats, strips, and reforms the naphtha charge, yielding an 87 F-1 clear Houdriformate. This is depropanized and depentanized, with propanes going to refinery fuel, and butanes and pentanes blended into the final gasoline product. The depentanized effluent is thermally reformed, flashed, and debutanized. The C_3-C_4 cut goes to catalytic polymerization, with resultant polymer gasoline going to blending with debutanized reformate, butanes, and pentanes. Table 2 compares yields for this route with those using aromatics extraction.

Two Iso-Plus processing plants are under construction, with completion expected this year. One, in Italy, has a nominal design capacity of 4,000 bbl. per day. The other, in the United States, will be more than 10 times that size in design capacity.

TABLE 3—PILOT-PLANT YIELDS AND INSPECTIONS, ISO-PLUS THERMAL PROCESSING OF CATALYTIC REFORMATES

	Reformate from East Texas naphtha, 260°-385° F. (A.S.T.M.)			
	84 F-1 clear catalytic		89 F-1 clear catalytic	
Charge stock—	Weight per cent	Volume per cent	Weight per cent	Volume per cent
Yields:				
C_5+ reformate	74.5	71.8	81.0	78.6
Tar	5.6	4.5	3.9	3.2
Dry gas, C_3 and lighter	13.8		10.1	
Pentenes	2.4	2.9	2.5	3.1
Pentanes	2.0	2.6	2.1	2.7
Butenes	3.6	4.8	3.1	4.1
Butanes	2.5	3.5	1.9	2.7
Propene	2.8		2.5	
Potential catalytic polymer (calc.)*	5.0	5.4	4.3	4.7
Inspections:	C_5+	Heavy polymer	C_5+	Heavy polymer
Gravity, °A.P.I.	39.2	8.5	39.2	9.6
Distillation, A.S.T.M., °F.:				
I.b.p.	130	465	134	492
10 per cent	205	516	208	520
50 per cent	298	592	296	587
90 per cent	364		364	700
End point	426		420	
R.v.p.	3.5		3.2	
Octanes:				
F-1 clear of C_5+	99.6		100.0	
F-1 clear of C_5+ and catalytic polymer (calc.)	100.0		100.3	
Composition of heavy polymer free C_5+ reformate:				
Paraffin, vol. per cent	12.2		13.1	
Olefin, vol. per cent	5.6		4.5	
Naphthene, vol. per cent	2.8		1.9	
Aromatic (alkyl-benz), vol. per cent	76.3		77.4	
(Alkenyl), vol. per cent	3.1		3.1	

*Assumes 95 per cent recovery of butenes, 75 per cent recovery of propene, 90 per cent conversion to polymer.

TABLE 4—REFINERY ISO-PLUS THERMAL REFORMING OF 80.5 F-1 CLEAR CATALYTIC REFORMATE

Plant operating data:	
Charge rate, bbl. per day	5,700
Charge octane number, F-1 clear	80.2
F-1 at 3 cc. TEL per gallon	92.4
Product (C_5— 440° F.) yield, vol. per cent	80.0
F-1 clear octane number	94.4
Total potential debutanized gasoline yield*	86.4
F-1 clear octane number	95.2
Heater outlet temperature, °F.	1,000
Heater inlet pressure, psig.	850
Heater outlet pressure, psig.	615

Product yields:	Volume per cent	Weight per cent
Dry gas, C_3 and lighter		10.1
Butanes	8.7	6.6
C_5 to 440° F. gasoline	80.0	80.9
440° F. to e.p. heavy polymer	1.9	2.4
Light hydrocarbon breakdown:		
Methane and hydrogen		1.4
Ethylene		0.7
Ethane		2.1
Total C_3 and lighter		4.2
Propylene	4.0	2.7
Propane	5.0	3.2
Isobutane	0.5	0.3
Isobutylene	2.4	1.8
Normal butylene	3.9	3.1
Normal butane	1.9	1.4

*Includes catalytic polymer from propylenes assuming 75 per cent recovery and 90 per cent conversion plus catalytic polymer from butylenes at 95 per cent recovery and 90 per cent conversion.

U.O.P. REXFORMING

THE U.O.P. Rexforming process, announced in March 1955, is a combination of elements of a Platforming unit with those of a Udex solvent-extraction unit to economically make a product having unleaded research octane ratings exceeding 100 from a normal, full-boiling-range gasoline. This is accomplished by continuously reforming the low-octane paraffinic raffinate without incurring the higher operating costs which usually would be associated with high-severity catalytic reforming, or the greater capital investment required for the recovery of high-purity aromatics.

As the concentration of aromatics in a given charge stock increases in passing through successive beds of platinum-containing catalyst as in Platforming, the dehydrocyclization reaction (i.e., conversion of paraffins to aromatics) becomes definitely inhibited even though considerable quantities of paraffins may remain. For this reason all once-through reformates contain significant concentrations of paraffins boiling near the high end of the feed-stock distillation range. These are the very hydrocarbons which usually have clear octane ratings in the 0 to 40 bracket, hence it is easy to understand that even a few per cent of such low-octane components can seriously reduce the octane rating of the total blend.

The Rexforming process was developed to take advantage of this factor in the reaction kinetics of reforming over platinum by solvent-extracting the aromatics and subjecting the resulting paraffinic raffinate to further catalytic reforming. While this does not alter basic reaction kinetics, it has the same effect—that of displacing the equilibrium of the reaction in the desired direction to form more aromatics.

Another feature of the Rexforming process is that the solvent-extraction conditions can be adjusted to include a desirable amount of the low-boiling paraffins and naphthenes in the extract, along with the aromatics. These low-boiling paraffins and naphthenes, in quantity depending on the feed and process conditions, help to produce a well-balanced motor fuel.

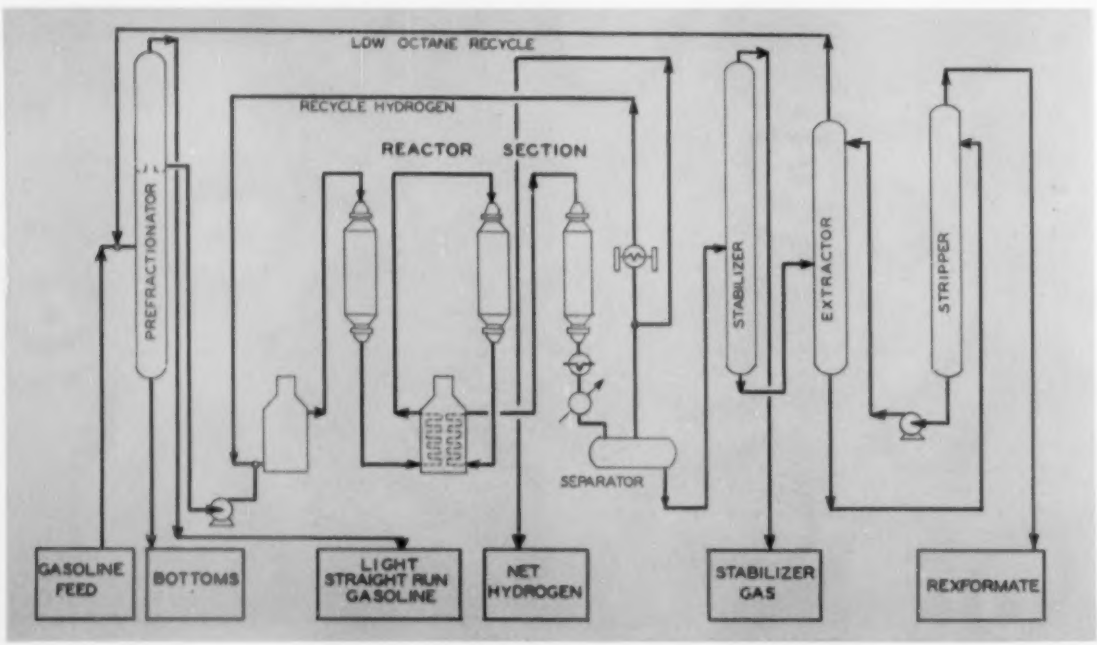
It is not necessary to obtain high efficiency-high purity extractions in the liquid-liquid extraction section of the Rexformer, which is similar in many respects to a Udex unit. This is because any aromatics which might get into the raffinate stream will not be "lost" to a low-value stream since in Rexforming this stream is recycled to the reforming section and returns to extraction again. This makes for construction and operation economies, since nitration-grade aromatic products are not sought.

Operating Economies

Operating economies in the Platforming section of the Rexformer are achieved also, since high-severity operations are not needed because of two factors: (1) aromatics are not permitted to build up towards equilibrium levels in the influents to the various reaction beds and (2) high concentrations of aromatics are unnecessary as there are no low-octane paraffins in the product to pull down the over-all rating. Because of the recycle-extraction feature, only mild reforming operating conditions are required which result in increased ultimate yields of liquid product and longer catalyst life; reactor inlet temperatures in Rexforming may be as much as 50° F. lower than for once-through Platforming for high-octane-motor-fuel production.

The process flow and equipment items needed are illustrated in the accompanying flow sheet. The two processing sections of the unit are labeled to indicate the combination of Platforming with Udex extraction. While a feed prefractionator is shown, this does not preclude the use of a pretreating operation, such as Unifining, to remove contaminants from an otherwise undesirable feed stock.

The stabilizer shown may be operated to entirely



debutanize the Rexformate or to cut it to desired front-end volatility. It would not be impractical to charge a wide-boiling stream which has been pretreated to the prefractionator, whence the bottoms cut would be a stove oil of high quality and the side and overhead streams as identified in the drawing.

Description of Process

The Rexforming process consists of several integrated parts: feed prefractionator, the reaction section, a stabilizer section, a stabilizer and an extraction section.

When processing a full-boiling-range gasoline, the charging stock is fed to a reboiler prefractionator which removes overhead a light gasoline fraction. The side cut from this column is the combined feed to the reaction section. The flow through the reactors which contain the Platforming catalyst, and through the heaters is similar to that of a Platforming unit. The reactor effluent, after cooling, passes to a separator, from which a hydrogen-rich gas is circulated to the reactors. The net vent hydrogen is also removed from this separator.

Extraction . . . The separator liquid is fed to a stabilizer which in this case serves as a debutanizer. The stabilized material is charged to an extraction column, which continuously rejects from the top of the column the low-octane-number components. This rejected stream is returned to mix with fresh feed, achieving selective conversion of low-octane heavy paraffins to high-octane components.

The separation in the extractor is selective in that the higher-boiling nonaromatics, and these are the lowest octane constituents of a reformate, are least soluble in the solvent. On the other hand, the aromatics and the lower-boiling nonaromatics, both of which are the high-octane components, are relatively more soluble and are removed from the extractor with the rich solvent.

Dissolved hydrocarbons are removed from the rich solvent by stripping, yielding a gasoline of well-balanced boiling range as the high-octane product of the process. Lean solvent from the stripper is returned to the extractor to complete the solvent cycle.

Recycle operation . . . In the Rexforming process, the reaction section can be operated at mild conditions to produce an effluent having an octane number of 75 to 85 F-1 clear and containing 35-45 per cent aromatics. The extraction section serves to separate from this effluent a stream of increased aromatic content, containing the highest-octane paraffins in the reactor effluent. This stream, the Rexformate, when of 100 clear octane number, will contain 60-65 per cent aromatics.

The remaining low-octane, higher-boiling paraffins are left in the raffinate stream, to be recycled to the reforming section for further processing. Furthermore, minor amounts of aromatics can be left in the recycle raffinate stream without effect on the efficiency of the process. Thus, investment and operating costs for the extraction section are much lower than those for extraction operations designed to make pure aromatics at high recoveries.

Table 1 illustrates the effectiveness of Rexforming on a typical Mid-Continent full-boiling straightrun gasoline and, for contrast, with such a refractory feed as a Middle East naphtha. In both cases good yields of above 100 octane and 98 octane research motor fuel, respectively, were obtained.

Table 2 is indicative of the investment and operating cost for a 5,000-bbl. per stream day Rexformer designed to process a full-boiling-range Mid-Continent gasoline. As will be seen, the capital investment will be approximately $350 per barrel and the unit cost about 30 cents a barrel to operate. The increased yield from Rexforming is an important factor in making comparative economic studies at lower octane levels. Rexforming economics might also be improved in some instances by diverting a part of the highly paraffinic recycle to jet fuel blending.

Three Rexformers are scheduled to come on stream in the United States in 1956. They are the 5,500-bbl. per day Aurora Gasoline Co. unit at Detroit, the 6,000-bbl. per day unit of Cities Service Oil Co. (Del.) at Ponca City, Okla., and the 3,800-bbl. per day unit of Cosden Petroleum Corp. at Big Spring, Tex. A number of Platforming units which are either operating or in design stages contain provisions for eventual conversion to Rexforming.

The Rexforming process was originated and developed by Universal Oil Products Co., which licenses the process.

TABLE 1—REXFORMING OF LOW-OCTANE NAPHTHAS

	Mid-Continent		Middle Eastern	
	Charge	Rex-formate*	Charge	Rex-formate*
Gravity, °A.P.I.	52.2	39.5	57.4	45.4
100 ml. dist., °F.:				
I.b.p.	225	130	204	121
5 per cent	248	163	228	148
10 per cent	258	182	236	163
30 per cent	282	242	259	230
50 per cent	316	290	282	275
70 per cent	340	329	304	304
90 per cent	366	367	334	345
95 per cent	371	385	346	360
End point	403	444	386	418
Research clear octane	31.7	†100.8	...	98.0
Aromatics, vol. per cent	9	74.4	12	58.8
Naphthenes, vol. per cent	43	3.0	19	...
Yields, charge basis:				
Debutanized Rexformate, vol. per cent		76.8		75.6
10 lb. R.v.p. Rexformate, vol. per cent		86.0		84.7
Separator gas, s.c.f./bbl.		935		610
Debutanizer gas, s.c.f./bbl.		301		385

*Properties and yields are for debutanized Rexformate except for 10-lb. R.v.p. gasoline yield. †C.R.C. octane scale extension.

TABLE 2—ESTIMATED CONSTRUCTION AND OPERATING COSTS, 5,000 BBL. PER STREAM DAY REXFORMER

Erected cost (within battery limits)*	$1,750,000
Operating costs:	Cents/bbl.
Labor at $2.75 per hour	4.2
Laboratory	1.0
Utilities:	
Fuel at 15 cents per M.M.B.t.u.	†8.6
Power at 0.8 cent per kw.-hr.	1.6
Steam at 30 cents per 1,000 lb.	1.6
Water at 1 cent per 1,000 gal.	1.3
Catalyst	5.0
Solvent	1.6
Maintenance, labor and materials‡	3.0
Insurance and property taxes§	2.0
Total operating costs¶	29.9

*4,300 bbl. per stream day fresh naphtha charge to reactor section. †No credit taken for fuel gas make. ‡ Three per cent of investment per year. §Two per cent of investment per year. ¶Excludes royalty, depreciation, administration, and overhead.

POWERFORMING

ADVANCE-DESIGN Powerforming is a fixed-bed cyclic process. It employs a new Esso Research-developed platinum catalyst.

It uses four, five, or six reactors with three, four, or five on stream while one is being regenerated by special technique. The cycle on any one reactor varies from 5 to 15 days.

Due to the new regenerating technique, the catalyst retains its high initial activity indefinitely. Excellent yields of high octane number product are achieved at high feed rates. The process also gives a high yield of hydrogen.

Feed stocks . . . Typical feeds consists of a low-octane virgin naphtha or a cracked naphtha virgin blend. Excellent results have been obtained with blends containing fluid coking naphtha.

Hydrofining of feed stocks is not necessary but is generally preferred. A flow plan and some typical data are shown.

Two prototype units of this process are now in operation in the United States and Canada and several others are building or planned. The two operating Powerformers are a 3,000-bbl. per day unit at Esso Standard Oil Co.'s Baltimore refinery and a 2,500-bbl. per day unit at the Edmonton, Alta., refinery of Imperial Oil, Ltd.

Process flow . . . Feed for the process first passes to the Hydrofiner reactor for hydrogen treat. This step may be omitted if a saturated, straightrun, sweet naphtha is being used; however, it is necessary with cracked fuel naphtha or blends containing these components.

Effluent from the Hydrofiner passes to a hydrogen separator and then to an absorber stripper.

Bottoms from the absorber stripper then proceed to the first of the Powerforming reactors. Powerforming feed passes through at least three of the reactors in series and may be passed through as many as five.

Effluent from the last Powerforming reactor is cooled and sent to a separator. A gas rich in hydrogen is taken from the separator and split in two streams. One goes to the absorber stripper and the other is used as recycle for the Powerforming reactor.

Bottoms from the separator are heated and fed to a debutanizer.

Information about the Powerforming process may be obtained from Esso Research & Engineering Co., New York.

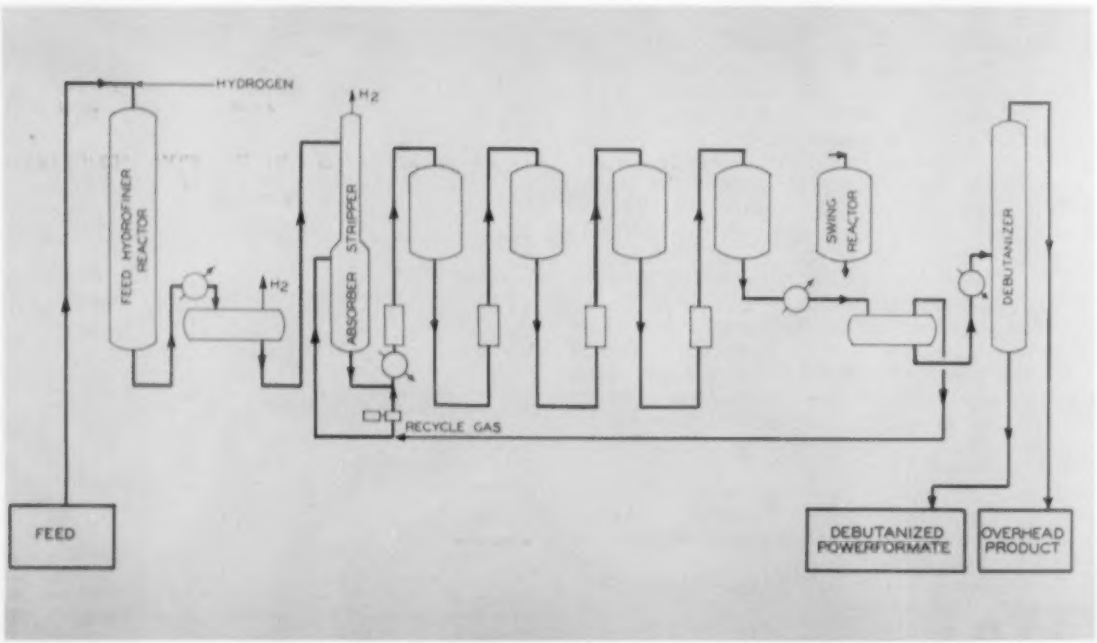
TABLE 1—INSPECTIONS OF FEED STOCKS FOR POWERFORMING

	Light Arabian	Heavy Arabian	Mixed Louisiana	Heavy W. Tex
Gravity, °A.P.I.	61.9	54.0	60.3	50.6
Sulfur, wt. per cent*	0.03	0.07	0.005	0.20
C.F.R.-R. octane, clear	39	29.7	53	46.1
Distillation:				
10 per cent	216	276	205	288
50 per cent	241	326	231	308
90 per cent	282	370	293	350

*Before Hydrofining.

TABLE 2—OPERATING RESULTS WITH POWERFORMING

Feed stock—	Light Arabian	Heavy Arabian	Mixed Louisiana	Heavy W. Tex
Research octane:				
Clear	95	100	98	98
+3 cc.	100.5	103	103	102
Motor octane:				
Clear	85.5	88.5	88	87
+3 cc.	92	93.5	93	92
Yields:				
C_5+, vol. per cent	72.5	69	72.5	81
C_4, vol. per cent	10.5	11.5	10.5	6.5
C_1-C_3, wt. per cent	12.5	16.5	12	8.5
H_2, wt. per cent	1.4	0.7	1.8	1.8
H_2, s.c.f./bbl.	680	350	880	930



CATFORMING

CATFORMING, a process for producing high-octane gasoline from low-quality naphthas with minimum operating and investment costs, was first announced to the petroleum industry in February 1951. The catalyst differs from other platinum reforming catalysts in that the platinum is impregnated on a silica-alumina carrier and, therefore, it has many unique and distinctive properties.

1. The catalyst has a complete tolerance for water which permits charging saturated streams without drying or prefractionation, eliminates the need for drying recycle gas after amine desulfurization, and permits a simple, inexpensive regeneration using steam diluent rather than inert gas.

2. A high yield of gasoline is achieved during the entire period of operation. The yield-octane relationship does not change significantly as the catalyst ages, nor does it change after regeneration.

3. Because of a complete tolerance for nitrogen, no naphtha feed stock need be rejected or pretreated to reduce nitrogen content.

4. Although the process is basically nonregenerative, carbon may be removed from the catalyst after an extended period of operation or after an operating upset by passing air and steam over the catalyst once-through. No additional equipment is required.

With selected stocks, octane levels above 100 can be produced by straight Catforming, but for many of the poorer stocks the combination of reforming plus lead reaches a practical ceiling at the 97-98 octane level. However, it is still possible for most refiners to produce blend components for 100-octane premium fuel with minimum additional investment by subsequent separation or treating of the Catformate.

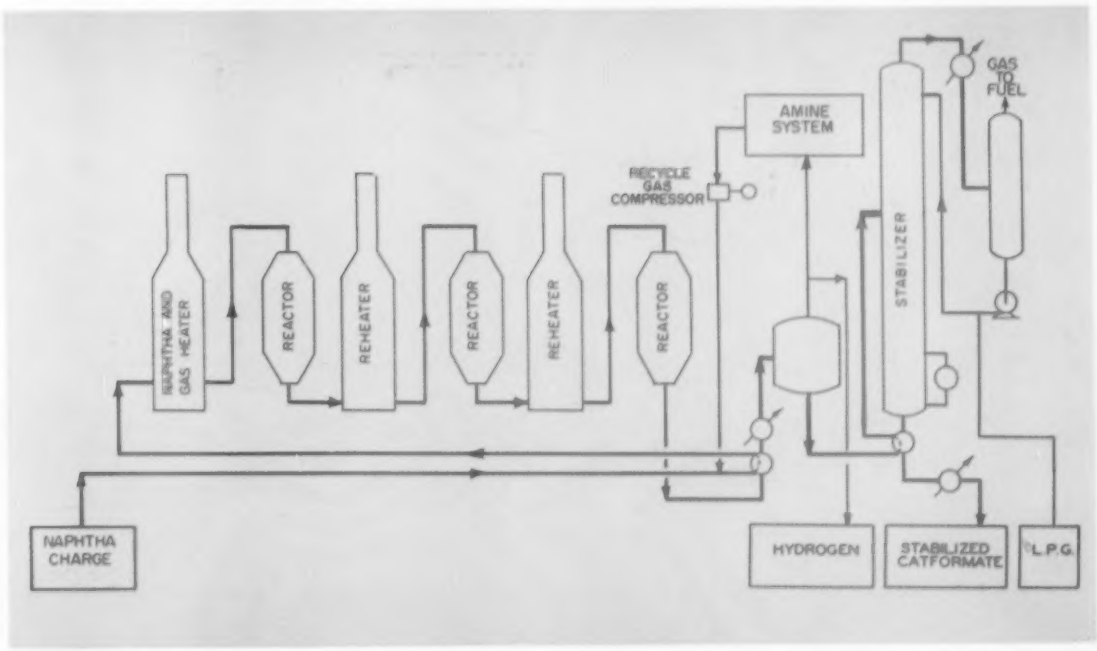
Table 1 shows one possibility, particularly attractive where catalytic cracking is also used. A feed stock of only average quality is reformed to produce a debutanized Catformate of 97 F-1 octane which is then separated by simple fractionation into a high and low-octane stream. The 66 per cent bottoms fraction, with 100 leaded octane, can be blended with the front end of catalytic cracked naphtha or with other light high-octane components such as isopentane. (See Atlantic Pentafining process.)

Flow . . . The process consists of mixing incoming naphtha with recycle hydrogen, heating to reaction temperature, and passing the mixture in vapor phase over three catalyst beds in series. The gasoline is condensed and stabilized in a conventional manner. With high sulfur naphthas, hydrogen sulfide is scrubbed from the recycle hydrogen before rejoining the naphtha bed stream.

There are 27 Catformers operating or under construction with capacities ranging from 600 to 15,000 bbl. per day. The average unit daily capacity is 4,500 bbl. Of these installations, five are combination Unifiner-Catformer units which are available under a single license agreement with Atlantic Refining Co.

TABLE 1—CATFORMING PLUS FRACTIONATION

	Feed	Debutanized Catformate	Fractionated 66 per cent bottoms
°A.P.I.	55.0	49.9	45.2
Reid vapor pressure	0.7	3.8	0.2
Sulfur, per cent	0.05	<0.001	<0.001
Naphthenes, per cent	34		
F-1 clear octane	43.0	86.8	93.0
A.S.T.M. distillation:			
Over	200	143	218
10 per cent	239	199	247
50 per cent	290	261	291
90 per cent	340	342	351
End point	381	392	396
Yield, vol. per cent of feed		85.4	56.3
F-1 octane +3 cc. TEL		97.0	100.0
Total C_{4}+ yield = 94.6 vol. per cent of feed			



ULTRAFORMING

ULTRAFORMING is a fixed-bed catalytic reforming process developed by Standard Oil Co. (Indiana) to take advantage of the higher yields and octane numbers obtained by reforming at low pressure. Aromatization of paraffins is also favored so that higher yields of aromatics and hydrogen are also produced.

Low-pressure operation with platinum Ultraforming catalyst is made possible by a novel regeneration technique which completely restores both activity and activity maintenance to that of fresh catalyst. As shown in Table 1, 22 units with total capacity of over 200,000 bbl. per day have been publicly announced; 10 of these are now in operation.

Process description . . . A flow diagram of the Ultraforming process is shown. The swing reactor makes it possible to regenerate without interrupting reforming operations. As shown, catalyst in the swing reactor is being regenerated while naphtha is being processed in the other three.

Naphtha charge and hydrogen-rich recycle gas are heated in a furnace to reactor-inlet temperature and are then passed through a series of reactors. The predominant reactions are endothermic and cause a temperature drop across each reactor; furnaces between the reactors reheat the mixture. Effluent is condensed and separated into a liquid stream and a hydrogen-rich gas. The liquid is stabilized to the desired vapor pressure and withdrawn as finished reformate. Part of the gas is recycled; the rest can be used as a source of hydrogen for other processes or as fuel.

When catalyst activity in a reactor declines, that reactor is temporarily isolated from the naphtha-processing system and is replaced by the swing reactor. Naphtha processing continues while catalyst in the isolated reactor is regenerated with air and inert gas. After regeneration, the reactor is placed back on stream, and the swing reactor is then available until another reactor requires regeneration.

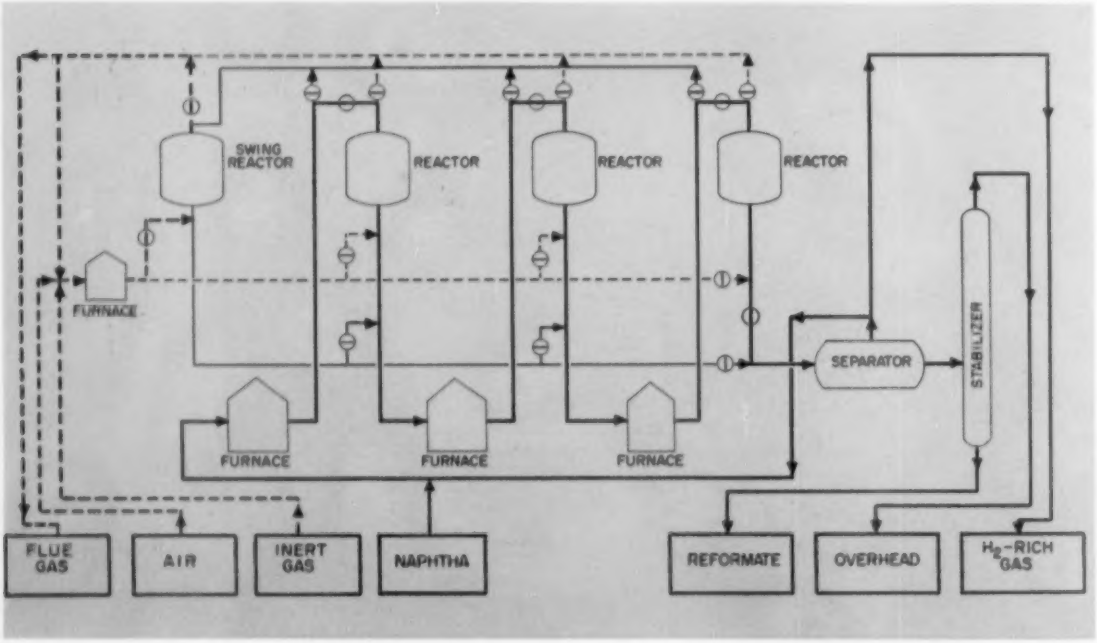
Because of the great flexibility inherent in Ultraforming, process designs and processing procedures are tailor-made to meet each particular refinery situation and to achieve full utilization of Ultraforming catalyst at all times. To minimize investment, it may be desirable in some cases to eliminate the swing reactor and employ other arrangements that have been developed for effecting the required Ultraforming type of regeneration with minimum offstream time.

Operating conditions . . . Ultraforming is usually carried out at a pressure of 200-300 psi. and a reactor-inlet temperature of 900°-970° F. Hydrogen recycle rate, space velocity, and regeneration frequency are adjusted to the particular characteristics of the charge and to the produce desired.

Advantages of low pressure . . . Low-pressure operation offers four major advantages over conventional platinum-catalyst operation; higher octane numbers, higher gasoline yields, higher effective catalyst activity and yield maintenance, and greater flexibility. Low pressure also gives higher yields of aromatics and byproduct hydrogen. Some of these advantages are illustrated for a Mid-Continent naphtha by comparing Ultraforming 300-psi. operation with conventional 500-psi. operation:

	Ultraforming	Conventional platinum reforming
At constant temp. and space velocity:		
Octane number, research, clear	95	91
Yield at constant octane (95 research, clear):		
10-lb. gasoline, volume per cent	93	87
Aromatics, volume per cent	47	44
Hydrogen, s.c.f./bbl.	1,150	930

A plant of given capacity operating at low pressure can



therefore produce gasoline of much higher octane. Moreover, at the same octane level, a plant operating at low pressure can produce higher yields of gasoline, aromatics, and hydrogen, and can either process more naphtha or operate with less catalyst.

Because Ultraforming regeneration fully restores catalyst activity, and because Ultraforming catalyst can be regenerated many times, the process permits a wide range of operating conditions, recovery from operating upsets, and the use of charge stocks varying widely in character. If excessive coke forms on the catalyst for any reason, the catalyst can be regenerated completely to restore operations to normal.

Yields . . . As shown in Table 2, Ultraforming of Gulf Coast naphtha, containing 63 per cent naphthenes, produces more than 93 per cent of 10-lb. gasoline at the 100-octane level. Mid-Continent naphtha, containing 44 per cent naphthenes, gives 83 per cent of 100-octane reformate. Highly paraffinic Kuwait naphtha with only 19 per cent naphthenes, yields more than 81 per cent of 95-octane gasoline.

Catalyst . . . Results with the highly paraffinic naphtha

TABLE 1—ULTRAFORMING UNITS

Company—	Cap., bbl./ stream day	Status
Pan-Am Southern Corp.:		
1. El Dorado, Ark.	6,200	Operating
Standard Oil Co. (Indiana):		
2. Casper, Wyo.	3,700	Operating
3. Mandan, N. D.	6,000	Design
4. Sugar Creek, Mo.	14,000	Operating
5. Whiting, Ind.	14,000	Building
6. Whiting, Ind.	21,000	Design
7. Wood River, Ill.	9,000	Operating
American Oil Co.:		
8. Texas City, Tex.	21,200	Operating
9. Yorktown, Va.	7,600	Design
Utah Oil Refining Co.:		
10. Salt Lake City, Utah	5,500	Building
Canadian Petrofina Limited:		
11. Montreal, Que., Canada	3,600	Operating
Derby Refining Co.:		
12. Wichita, Kans.	2,500	Design
Great Northern Oil Co.:		
13. Pine Bend, Minn.	5,000	Operating
Hancock Oil Co.:		
14. Long Beach, Calif.	3,000	Design
Humble Oil & Refining Co.:		
15. Baytown, Tex.	20,000	Operating
16. Baytown, Tex.	20,000	Operating
International Refineries, Inc.:		
17. Wrenshall, Minn.	2,800	Design
Leonard Refineries, Inc.:		
18. Alma, Mich.	2,500	Operating
Pure Oil Co.:		
19. Smiths Bluff, Tex.	15,000	Building
Raffineria Garrone:		
20. Genoa, Italy	5,000	Design
Raffinerie Siciliane Oli Minerali:		
21. Milan, Italy	5,000	Design
Standard Oil Co. (Ohio):		
22. Cleveland	11,000	Building
Total	203,600	

"Because Ultraforming regeneration fully restores catalyst activity and because Ultraforming catalyst can be regenerated many times, the process permits a wide range of operating conditions, recovery from operating upsets, and the use of charge stocks varying widely in character."

demonstrate the unusual effectiveness of Ultraforming with even the least-favorable charge stock. This arises from the nature of the Ultraforming catalyst. Most platinum catalysts have good activity for conversion of naphthenes to aromatics. Even total conversion of naphthenes to aromatics, however, would not be sufficient to produce the high-octane motor fuels now appearing on the market and projected for the future.

A good reforming catalyst must also convert paraffins to aromatics. The ability of Ultraforming catalyst to do so makes possible the production of high-octane reformates in high yield from even low-naphthene, high-paraffin feed stocks. The excellence of Ultraforming catalyst for aromatization of paraffins also makes the process attractive for producing aromatic concentrates from selected fractions of virgin naphthas.

Extensive studies show that the life of Ultraforming catalyst may be well above 100 bbl. of feed per pound of catalyst. The replacement cost is about $4.20 per pound, including credit for platinum in used catalyst. For operations at 300 psi., catalyst cost should therefore be less than 4 cents per barrel—no more than that of catalytic cracking. American Cyanamid Co. cooperated in developing Ultraforming catalyst and now supplies it.

Ultraforming process licenses are available from Standard Oil Co. (Indiana) and Esso Research & Engineering Co. They give operating rights under patents of Standard (Indiana) and Esso Research, including future improvements.

TABLE 2—ULTRAFORMING YIELDS

Charge naphtha—	Gulf Coast		Mid-Continent		Kuwait	
A.S.T.M. dist., °F.:						
Initial	189		193		193	
10 per cent	212		239		220	
50 per cent	254		280		266	
90 per cent	324		328		330	
End point	360		360		366	
Composition, volume per cent:						
Paraffins	28		48		70	
Naphthenes	63		44		19	
Aromatics	9		8		11	
Octane No., research, clear	66		45		35	
Products—						
C_5+ reformate:						
Octane No., research, clear	90	100	90	100	90	95
Yield, vol. per cent	90.5	80.7	85.6	76.4	79.5	74.6
R.v.p.	2.4	3.2	3.2	4.7	4.6	5.0
Butanes, vol. per cent	1.7	5.8	4.3	8.4	8.7	11.3
Dry gas, wt. per cent	4.3	9.6	7.0	11.8	10.2	13.0
Hydrogen, s.c.f./bbl.	1,200	1,460	1,010	1,110	675	710
10-lb. gasoline:						
Octane No., research, clear	90	100	90	100	90	95
Yield, vol. per cent	106.5	93.6	100.8	83.2	87.8	81.6

FLUID HYDROFORMING

"The catalyst is cheap and rugged and not susceptible to poisoning by sulfur or water. Products are essentially sulfur free. Selectivity of catalyst does not fall off with continued use."

FLUID HYDROFORMING is a flexible, fully continuous process for converting virgin and cracked naphthas to high-octane gasoline. Using the fluidized solids technique, it employs a molybdena-alumina catalyst. At present, 115,000 bbl. per day of capacity is being installed in the United States and abroad.

A great variety of feed stocks has been reformed to products in the 90 to 100-octane number range. Both narrow and wide-cut feeds have been processed. There is no limitation on feed end point, and feeds containing cracked stocks can be reformed with excellent yields with pretreatment for olefin saturation or sulfur removal.

The catalyst is cheap and rugged and not susceptible to poisoning by sulfur or water. The products are essentially sulfur free. Selectivity of the catalyst does not fall off with continued use.

Operation . . . The finely divided catalyst, behaving much like a fluid, circulates continuously between the reactor and the regenerator. The preheated naphtha feed enters the bottom of the reactor where it meets a hot isothermal bed of catalyst. The reformed products leave the catalyst bed and pass through separators where entrained catalyst is removed and returned to the bed. The overhead products are heat exchanged, cooled and separated into gaseous and liquid products.

After stabilization, the liquid product is removed as high-octane gasoline. A portion of the gaseous product is compressed, heated, and recycled to the reactor to supply additional heat.

To eliminate carbon which deposits on the catalyst during the reaction, a portion is continuously withdrawn and allowed to flow to the regenerator. Here carbon is burned off with air which liberates large quantities of heat. The heat may be used to produce steam or preheat the feed. The hot regenerated catalyst returns as a fluidized stream to the reactor, supplying some of the heat required and completing the continuous cycle.

Yields from Fluid Hydroforming at any octane level depend on the feed-stock quality.

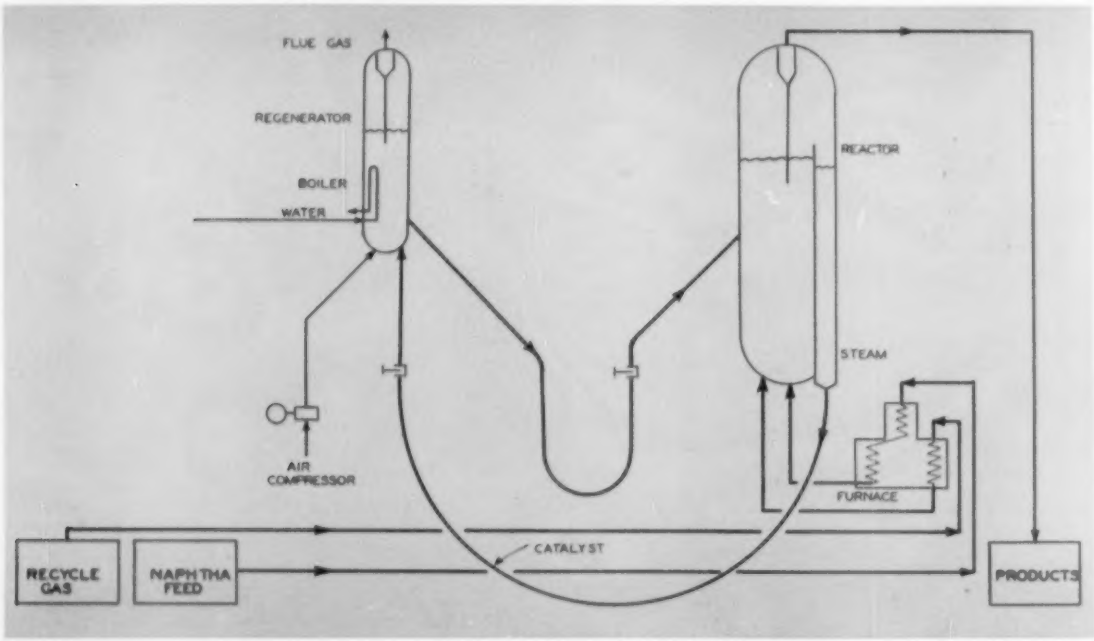
Ten Fluid Hydroforming units with a total capacity of 114,230 bbl. per day have been built or are now under construction. Four of these are licensed units.

The Fluid Hydroforming process was developed and is being licensed by Esso Research & Engineering Co., New York.

TABLE 1

Hydroforming of a 250° to 325° F. West Texas Virgin Naphtha to Produce a 92-Octane Number (A.S.T.M. D 908, Research Method) C_5+ Gasoline Without TEL Addition

	Model I
Reactor:	
Pressure, psig.	200
Temperature, °F.	895
Recycle gas:	
Rate, cu. ft. per bbl.	4,700
Preheat temperature, °F.	1,200
Naphtha:	
Preheat temperature, °F.	1,000
Solids circulation, lb. per lb. of naphtha feed.	
Catalyst (catalyst-to-oil ratio)	1.0
Regenerator:	
Pressure, psig.	200
Temperature, °F.	1,125
Cooling-coil duty, B.t.u. per lb. of feed	100
Air standard, cu. ft. per bbl. of feed	541



ORTHOFORMING
(Fluid Hydroforming)

THE Orthoforming process is a variation of fluid Hydroforming. Its design stems from the commercial success of the Orthoflow type of fluid catalytic cracking developed by M. W. Kellogg Co., licensors.

The process employs a molybdena-alumina catalyst in microsphere form. It differs from the original "side by side" version of fluid Hydroforming, also licensed by Kellogg, in superimposing the regenerator directly over the reactor in a single vessel. This simplified design reduces construction costs, improves heat economy, and promotes flexibility of operation.

Catalyst flow . . . By eliminating external catalyst transfer lines, the Orthoforming design confines the high-pressure, high hydrogen-gas flow entirely within the reactor-regenerator vessel. With catalyst carrier lines immersed in the hot catalyst bed, heat loss is confined to that from the vessel alone. The straight-line flow of catalyst cuts turbulence and transfer-line erosion.

Spent catalyst flows from the top of the reactor bed into the central stripper which has a high ratio of length to diameter. This shape plus its location inside the reactor gives the stripper a high efficiency for removal of entrained product, absorbed hydrocarbons, and chemisorbed hydrogen from the spent catalyst.

Stripped catalyst is lifted straight upward to the regenerator through the spent-catalyst riser. Regenerated catalyst returns to the bottom of the reactor through a straight standpipe.

The fluid Hydroforming process provides efficient contacting of catalyst with hydrocarbons and air, for isothermal reaction and regeneration. During extended operating periods, high yield can be maintained by controlling catalyst activity decline with continuous or periodic addition of fresh catalyst.

High carbon yield resulting from high-severity or poor-quality feed can be dealt with successfully. This allows the reforming of thermally cracked, high sulfur stocks with a high end point which cannot be processed successfully by some other reforming techniques. Naphthas comprising up to 15 per cent of cracked material can be reformed.

Yield and product inspection data from commercial operation are shown in Table 1. An economics summary for a typical unit is shown in Table 2.

Operating conditions may vary over the following approximate ranges: Reactor pressure 200-500 psi., reactor temperature 900°-950° F., regenerator pressure 210-510 psi., regenerator temperature 1,000°-1,100° F. Space velocity can range from 0.30 to 0.80 W/hr./W and catalyst to oil ratio from 0.25 to 1.00. Hydrogen recycle is possible over a wide variation of 4,000-8,000 cu. ft. per barrel of feed.

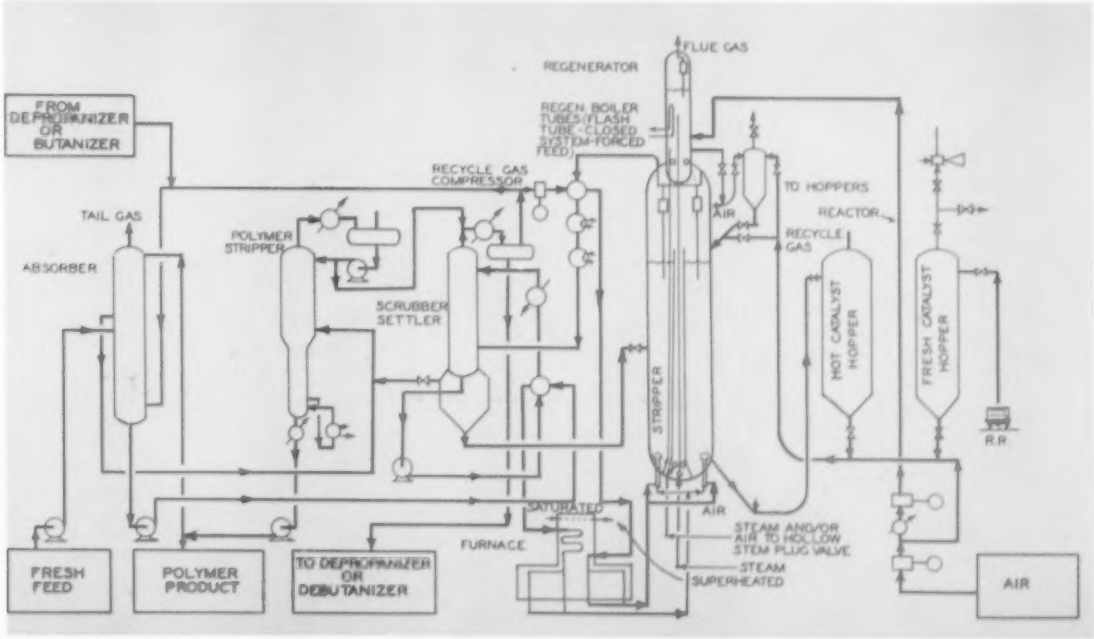
TABLE 1—TYPICAL OPERATING RESULTS FOR A COMMERCIAL ORTHOFORMER

(Feed—198°-371° F. mixed virgin naphtha, plus 6.7 per cent coke still naphtha. Sulfur, weight per cent 0.065. Research octane 48.8)

Yield—			
Hydrogen, cu. ft./bbl.	624	C_{5+} liquid, vol. per cent	77.6
CH_4, wt. per cent	2.0	Coke, wt. per cent	1.3
C_2—, wt. per cent	3.3	Sulfur, wt. per cent	0.06
C_3—, wt. per cent	5.0	Wt. balance, per cent	99.6
Butanes, vol. per cent	7.4	Orthoformate:	
C_{5+} gasoline, vol. per cent	76.2	°A.P.I.	46.4
		R.v.p.	5.0
Polymer, vol. per cent	1.4	Research octane clear	92.1

TABLE 2—ECONOMICS SUMMARY FOR 30,000-BBL. UNIT

Capital cost, per bbl.	$210.00
Labor, utilities, and maintenance, per day, per bbl. of capacity	$ 0.25
Royalty, taxes, and insurance, per day, per bbl. of capacity	$ 0.06
Credit for byproduct fuel gas and steam, per day, per bbl. of capacity	$ 0.37



CATALYTIC REFORMING

SINCLAIR RESEARCH LABORATORIES, INC., and Baker & Co. announced in May 1953 the development of a new platinum catalyst as the basis for an improved reforming process. Units totaling 44,000 bbl. per day are in operation with an additional planned capacity in excess of 90,000 bbl. per day in various stages of design and construction.

The RD-150 catalyst has high paraffin cyclization, naphthene dehydrogenation, and selective isomerization activities, low hydrocracking activity, and is resistant to permanent poisoning effects of normal concentrations of metals, sulfur, and water in the virgin naphtha.

Regeneration of the catalyst becomes necessary when the accumulation of carbonaceous materials has reduced the activity and selectivity below acceptable economic limits. The actual regeneration is accomplished by stopping the naphtha flow, purging and pressuring the unit with inert gas, and then admitting air while circulating flue gas until the burning is complete. Naphtha processing is then resumed after purging the inert gas from the system.

This regenerative ability of the RD-150 catalyst permits wide variations in operating conditions, and thus the unit can be "tailor made" for the processing of any naphtha charge stock. The operating conditions can be varied over the following ranges: 200-750 psig., 850°-970° F. reactor inlet temperature, 1 to 5 weight hourly space velocity based upon fresh feed, and 3 to 10 molal gas recycle ratio.

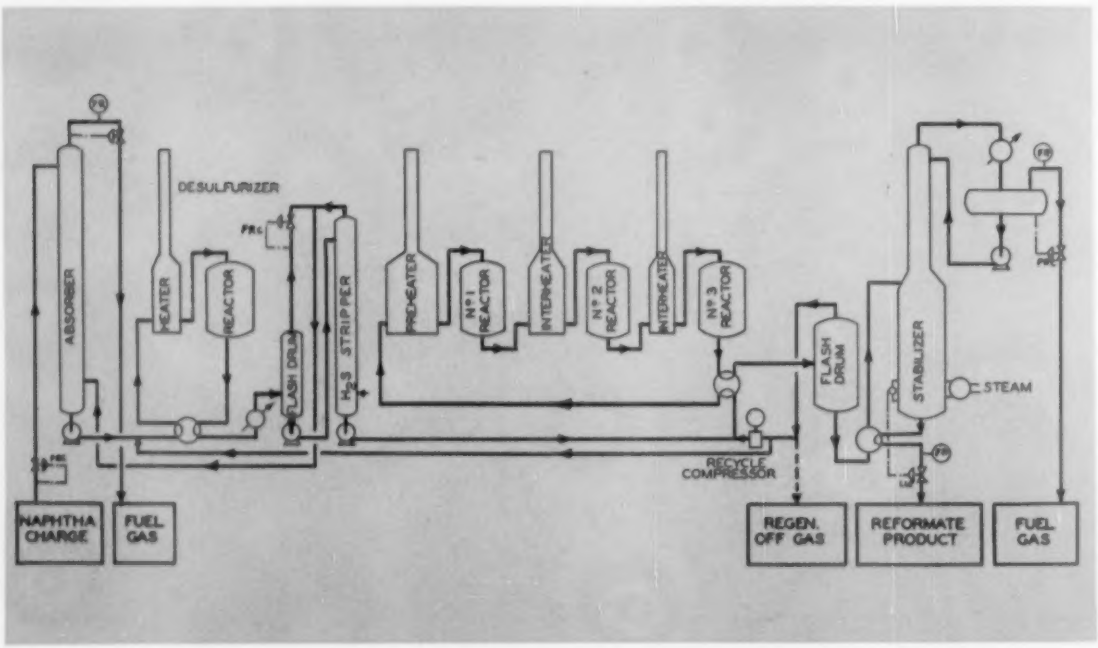
Typical yield data are shown for a range in naphtha qualities at a single operating pressure, and the effect of pressure is shown for the Mid-Continent naphtha.

The RD-150 catalyst is supplied by Baker & Co., which will also process the used catalyst for platinum recovery. M. W. Kellogg Co. is offering RD-150 catalyst for fixed-bed units.

TABLE 1—CATALYTIC REFORMING WITH SINCLAIR-BAKER RD-150 CATALYST YIELD DATA AT HIGH PRESSURE

Naphtha—	California	Mid-Continent	Middle East
Inspections:			
Gravity, °F.	52.2	53.2	56.1
I.b.p., °F.	227	258	225
10 per cent	240	273	248
50 per cent	257	295	292
90 per cent	300	331	352
End point, °F.	349	348	379
R.v.p., lb.	0.9	0.6	0.7
Chemical composition:			
Paraffins, vol. per cent	23.6	48.8	67.2
Naphthenes, vol. per cent	67.3	43.2	20.3
Aromatics, vol. per cent	9.1	8.0	12.5
Octanes:			
Research clear	62.0	39.0	33.7
Research +3 cc. TEL	79.4	64.0	57.7

Yields:								
Operating pressure	High		Low		High		High	
Research octane level	85.0	95.0	85.0	95.0	85.0	95.0	85.0	95.0
Dry gas, weight per cent	3.5	6.0	5.4	8.4	6.9	10.7	9.1	14.0
Butanes, volume per cent	1.2	2.9	2.6	4.6	3.7	6.4	5.7	9.2
C_4-e.p., volume per cent	92.7	89.8	91.3	88.0	91.1	87.3	89.6	84.7
C_5-e.p., volume per cent	91.5	86.9	88.7	83.4	87.4	80.9	83.9	75.5
C_5-e.p. reformate inspections:								
Gravity	44.5	42.6	46.3	43.9	47.8	45.6	50.4	47.8
R.v.p.	1.0	2.0	1.6	2.6	2.3	3.7	3.3	4.4
Research method clear	85.0	95.0	85.0	95.0	85.0	95.0	85.0	95.0
Research method +3 cc.	93.9	99.8	95.3	101.0	95.0	101.0	94.8	99.9



HYPERFORMING

HYPERFORMING is a continuously regenerating catalytic reforming process for upgrading low-octane naphthas. The product is essentially sulfur and nitrogen-free, of high octane, reduced in average boiling point, and gum stable.

The Hyperforming process is considered to have the following advantages:

1. Simultaneous octane improvement and desulfurization.
2. Continuous moving-bed system provides for the maintenance of catalyst activity and continuous operation.
3. Employs a low-cost catalyst insensitive to nitrogen, sulfur, and olefinic compounds.
4. Able to produce premium low-boiling gasolines by virtue of the relatively constant octane level throughput the boiling range of the reformate.

Description . . . This process utilizes a moving bed of special cobalt-molybdate catalyst. A recycle stream of hydrogen is employed to aid in controlling the catalytic reaction. Reactor temperatures are in the range of 850°-950° F. and the pressure is near 400 lb. Regeneration is continuous.

The catalyst is circulated by the Hyperflow (mass flow) catalyst-handling technique. The very low velocity used with this system results in minimum attrition losses. The catalyst moves downward through the reactor by gravity flow and is returned to the top of the reactor by means of the mass lift. Depending upon unit capacity, regeneration is carried out in the lift line or in a separate regenerator. Solids-handling features provide uniform catalyst distribution and motion.

The naphtha being processed is heat-exchanged with the reactor effluent and is introduced into the bottom of the reactor. The naphtha vapor, combined with part of the recycle gas, flows upward countercurrent to the catalyst. Hot hydrogen is introduced at several interheating points to supply heat of reaction. The naphtha leaves the top of the reactor as a thoroughly refined product.

Reactions . . . Reactions of the process include the combination of dehydrogenation of naphthenes to aromatics as well as hydrogenation of gasoline contaminants. Dehydrocyclization of paraffins is a feature leading to high-quality products from paraffinic feedstocks. A substantial amount of hydrocracking of the higher-molecular-weight hydrocarbons occurs together with isomerization of paraffins and naphthenes. Improved volatility of the product is also obtained.

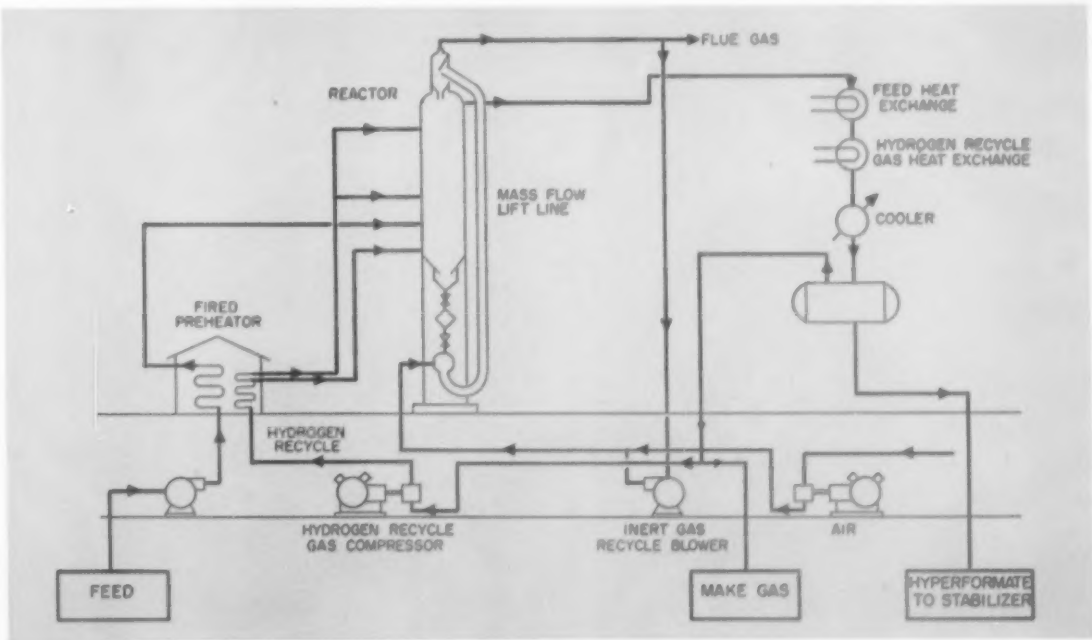
In the course of upgrading, the hydrogen released in the dehydrogenation of naphthenes is reused for the elimination of sulfur, nitrogen, and oxygen compounds in inferior stocks. Olefins are saturated as well.

Operating conditions . . . Hyperforming is carried out at pressure levels on the order of 400 psi. and the reactor temperatures are in the range of 800° to 900° F. Hydrogen recycle is utilized and space velocity is adjusted to the particular characteristics of the stock being processed.

Hyperforming is applicable to the upgrading of straightrun gasolines or straightrun-cracked gasoline mixtures, or both, to produce a product essentially free from nitrogen and sulfur, elevated in octane, reduced in boiling range, and gum stable.

Fractions boiling between 150° and 450° F. may be processed. Since the process incorporates regeneration facilities, there is no critical limitation on charge-stock boiling range or octane level of the product.

The process is licensed through the Commercial Development Division of Union Oil Co. of California.



THERMOFOR
Catalytic Reforming

THE T.C.R. process was developed in the Socony Mobil laboratories as a means of upgrading all types of low-octane-gasoline components into premium fuels. As the term Thermofor implies, the design embodies many principles derived from the familiar T.C.C. process.

The circulation of the catalyst is typical of the moving-bed process, since the catalyst flows through the reactor in a compact bed and is continuously regenerated in the kiln. The charge stock and the recycle gas are heated separately, combine, and enter the center of the reaction vessel. The vapor flow is both upwards and downwards to suitable vapor disengaging sections.

Two Streams Combine

The two vapor effluent streams combine and pass through heat exchangers to the fractionating section. Because a small amount of high-boiling polymer is formed in the reaction, two rerun towers are employed when producing both light and heavy reformates. Catalyst is brought up to reactor operating pressure (about 175 psi.) and is introduced into the reactor by means of a pressure lock system, controlled by a cycle timer, and leaves the vessel through a horizontal depressuring leg.

The kiln operates at essentially atmospheric pressure, an important safety feature of the process. Because coke deposition on the catalyst is comparatively low, circulation rates of under 50 tons per hour are sufficient for a 20,000-bbl. per day reactor.

High-sulfur feeds . . . The T.C.R. was designed to process high-sulfur cracked charge stocks without requiring pretreatment. Commercial data on high sulfur stocks show that the liquid products contain less than 5 per cent of the sulfur in the charge, the remainder being removed from the system as H_2S.

Reactor temperature is an important variable for controlling the reforming severity and can range from 950° to 1,000° F. The octane number of the reformate can be varied over a wide range, depending upon the blending requirements of the individual refinery. The catalyst used is a synthetic chromia-alumina bead, manufactured by Socony Mobil.

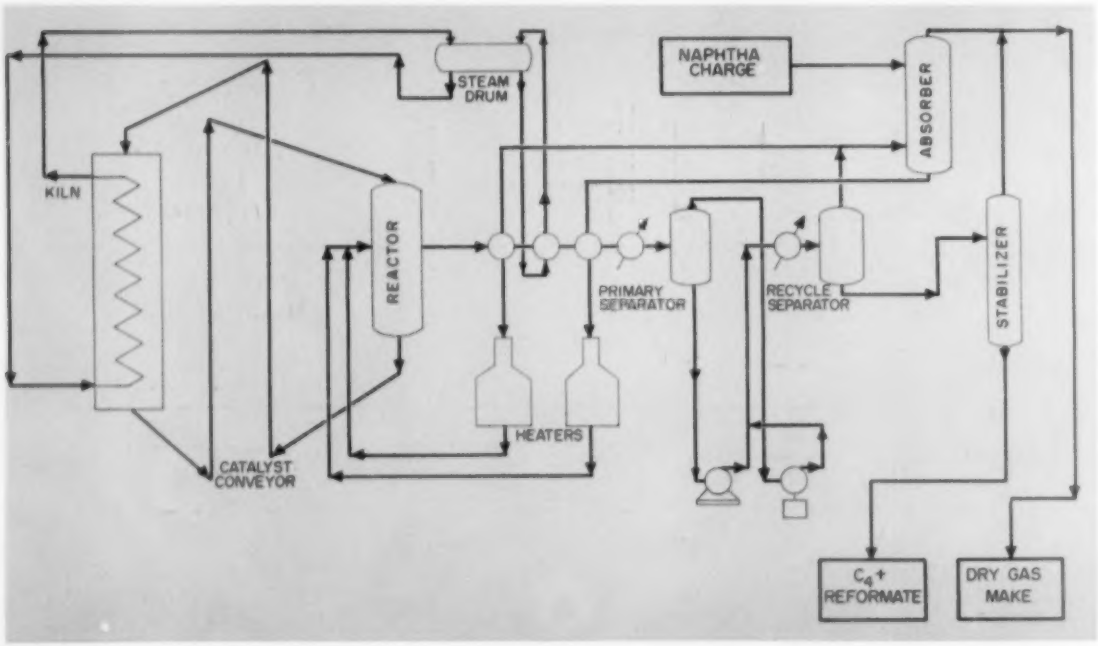
Two Units Built

In 1954, two commercial units were built, one at the Beaumont refinery of Magnolia Petroleum Co., and one at the Torrance refinery of General Petroleum Co. Both were designed for 19,000 bbl. per day throughput. On stream, both units have exceeded design capacity, and are operating satisfactorily.

Typical operations on 200° to 400° F. straightrun naphtha yield 88.9 per cent 10-lb. R.v.p. gasoline when raising the leaded research octane from 63.2 to 96.7. Data on yields and sulfur reduction when charging 50 per cent of cracked naphtha are shown in Table 1.

TABLE 1—COMMERCIAL YIELDS

Type of charge stock—	A blend of— 50% straightrun naphtha	50% cracked naphtha
Properties:		
Boiling range, °F.	200-400	250-400
Sulfur, weight per cent	0.22	1.45
Yields:		
C_4, volume per cent	3.4	
Light reformate, volume per cent	56.2	
Octane number (research + 3 cc. TEL)	94.0	
Sulfur, weight per cent	0.03	
Heavy reformate	29.0	
Octane number (research + 3 cc. TEL)	99.0	
Sulfur, weight per cent	0.05	
Polymer, volume per cent	1.6	
10-lb. R.v.p. gasoline, volume per cent	93.6	



Catalytic Reforming and Feed Desulfurization

THIS combination process, designed and licensed by M. W. Kellogg Co., utilizes a platinum catalyst developed by Sinclair Research Laboratories and Baker & Co. Byproduct hydrogen from the reforming reactions is combined catalytically with sulfur compounds in the naphtha feed, to produce hydrogen sulfide which is removed from the system with tail gas.

This combination process permits an unusually high yield-octane relationship at low utility consumption.

The process is readily adaptable to low-grade-naphtha feed stocks. The feed-preparation section may be designed to remove sulfur, metals, and water, all to trace levels. Thermally cracked naphthas can be charged directly to the unit.

Yields of high-octane reformates derived from Kuwait (or highly paraffinic naphthas) are only slightly lower than those from higher-grade Mid-Continent feed stocks. This is shown in Table 1. For example, the volume per cent yields of 95 clear octane C_5+ reformates derived from Kuwait and Mid-Continent naphthas differ by less than 3 per cent.

The catalyst has unusually long life, due to its regenerative feature, and it has high paraffin dehydrocyclization activity. This predominant conversion of paraffins to aromatics provides for increased liquid yield which raise the octane number while maintaining a low-volatility product.

This process yields release gas which is unusually rich in hydrogen, as shown in Table 1. This is a decided economic advantage in over-all refinery operation.

The typical naphtha reforming process employs three catalyst bed adiabatic reactors arranged in series, as shown in the flow diagram. An additional reactor is suggested as an alternate for Kuwait reforming, because of the severe conditions required in the third reactor. Regeneration is carried out in blocked-out operation.

Over 200,000 bbl. of capacity has been contracted or is anticipated utilizing Baker catalyst.

Examples of process economics are shown in Table 2.

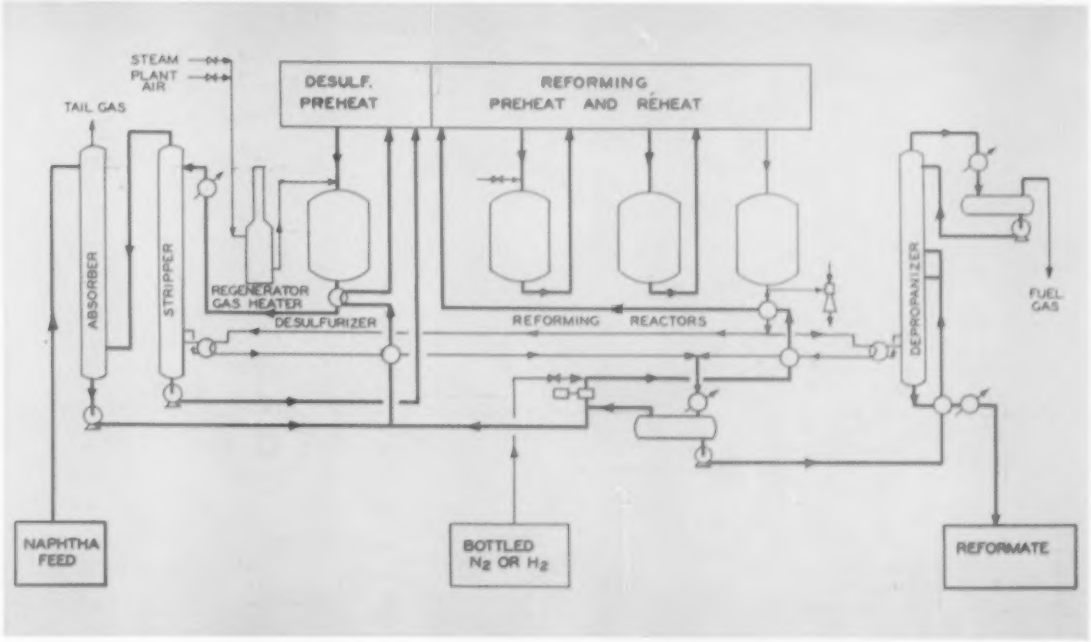
TABLE 1—PERFORMANCE DATA

Research clear O.N.	90	95	97
Yield, volume per cent on feed:			
10-lb. R.v.p. Mid-Continent reformate	97	94	92
C^5+ Mid-Continent reformate	86	83	81
10 psi. R.v.p. Kuwait reformate	95	91	88
C_5+ Kuwait reformate	84	81	78
Hydrogen production, s.c.f./bbl.:			
Mid-Continent	1,130	1,270	1,320
Kuwait	730	860	910

TABLE 2—OPERATING COST SUMMARY

(10,000-bbl. per stream day unit making 95 research octane number of C_5+ clear costs in cents per barrel)

	Kuwait	Mid-Continent
Fuel ($0.90/bbl.)	5.2	5.2
Power ($0.007/kw.-hr.)	2.3	2.0
Water ($0.007/1,000 gal.)	0.6	0.5
Catalyst—Reforming	10.8	6.7
Desulfurization	0.5	0.5
Labor ($55/day)	1.7	1.4
Supervision (15 per cent labor)	0.2	0.2
Total direct operating cost (cents/bbl.)	21.3	16.5
Maintenance (4 per cent process equip. invest.)	2.5	2.3
Property taxes and insurance (2 per cent process invest.)	1.8	1.6
Interest (4 per cent total process invest.)	3.6	3.2
Depreciation (10 per cent process equip. invest.)	6.2	5.7
Total operating cost (cents/bbl.)	35.4	29.3



UNIFINING U.O.P.

THE Unifining process is a versatile means of removing sulfur, nitrogen, oxygen, color bodies, and metal contaminants from petroleum distillates and of saturating olefins. The process may be applied to fractions of wide boiling ranges, from gasoline to heavy distillates, and which may be either straightrun or cracked, of high or low sulfur content.

Process . . . The schematic flow sheet indicates the arrangement for the simultaneous preparation of catalytic reformer feed stock and high-grade stove oil by the processing of coker distillates. The fractionator shown is not required in all applications of the process. The stabilizer likewise may be replaced by a stripper, rectified absorber, or other equipment as desired to best fit Unifining into a specific refinery process scheme.

The Unifining process operates in vapor or mixed phase at temperatures usually ranging from 500° to 750° F. and pressures of 300 to 800 psi., or higher, the exact conditions depending on the feed stock being processed and the results desired. The special cobalt-molybdenum-type catalyst is extremely rugged, has exceptional activity, and retains this even after operating for extended periods. It is not significantly affected by charge-stock contaminants commonly considered as catalyst "poisons."

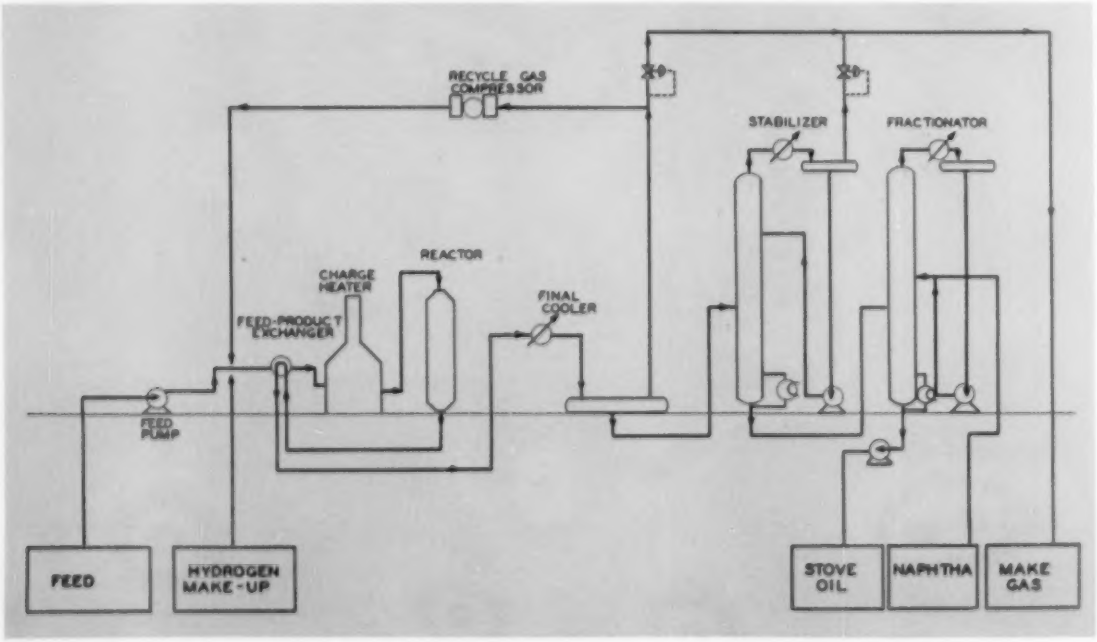
Unifining essentially is a selective hydrogenation process. It is not designed to increase the octane number of a gasoline but to prepare a charge for subsequent processing, such as Platforming or fluid catalytic cracking, or to improve stove oil and the like.

Commercial installations . . . The first commercial installation was made in 1953. At the present time over 40 units are operating, or in process of design or construction. (A license to use the Unifining process may be secured through either Universal Oil Products Co. or Union Oil Co. of California.)

TABLE 1—RESULTS OF UNIFINING VARIOUS STOCKS

	Straightrun naphtha and coker distillate		Wyoming diesel oil		Wyoming light cycle oil		Heavy vacuum gas oil	
Inspection—	Feed	Product	Feed	Product	Feed	Product	Feed	Product
Gravity, °A.P.I.	50.3	50.9	31.3	34.8	19.3	26.3	23.6	27.2
A.S.T.M. distillation, °F.:								
I.b.p.	254	254	452	260	430	395	576	440
10 per cent	280	279	523	492	458	420	674	600
50 per cent	322	327	560	547	483	462	793	760
90 per cent	406	414	603	596	515	508	879	870
End point	456	472	640	644	554	580	*902	*894
Mercaptan S, wt. per cent	0.02	Nil				Dr. Neg.		
Total sulfur, wt. per cent	0.11	0.01	2.1	0.14	2.54	0.06	1.94	0.39
Bromine number	12.9	0.4			21.8	2.7		
Basic nitrogen, p.p.m.	25.9	<1			48.0	7.0		
Arsenic, p.p.b.	27.0	<1						
Cetane number			46	52				
Liquid yield, vol. per cent charge		100.0		100.0		100.8		100.4

*97 per cent over.



UNIFINING
Union Oil

UNIFINING is a versatile catalytic hydrogenation process for removing sulfur, nitrogen, oxygen, and other contaminants from petroleum fractions.

The process may be applied to either straightrun or cracked feed stocks, whether light or heavy, of high sulfur content or low. The objectives of Unifining include:

1. Reduction in sulfur and nitrogen compounds.

2. Preparation of catalytic reforming feed stocks, whether straightrun or cracked.

3. Improvement in odor, color, gum, and storage stability.

4. Improvement in burning properties, cetane number, lead susceptibility, and susceptibility to catalytic cracking.

For a specific application of Unifining, the selection of optimum process conditions depends upon the character of the feed stock, the desired quality of the product, and on economic considerations.

The accompanying diagram shows an equipment arrangement for the simultaneous preparation of catalytic reformer feed and high-grade stove oil by the processing of coker distillates.

A 17,700-bbl. per stream day Unifining unit has been in full commercial operation for over a year treating a mixture of high-sulfur, high-nitrogen naphthas derived mainly from coking operations. The bulk of the product is reformer feed stock. Typical commercial data shown in the tables.

The first commercial installation was made in 1953. At the present time about 50 units have been licensed for operation. These units represent the application of Unifining to straightrun, thermal, catalytic, and coker naphthas; straightrun kerosine, diesels, and burner oils; vacuum and visbreaker distillates and gas oils; catalytic cycle stocks; aromatic distillates; and lube oils.

A Unifining license may be obtained from either Universal Oil Products Co. or Union Oil Co. of California, Commercial Development Division.

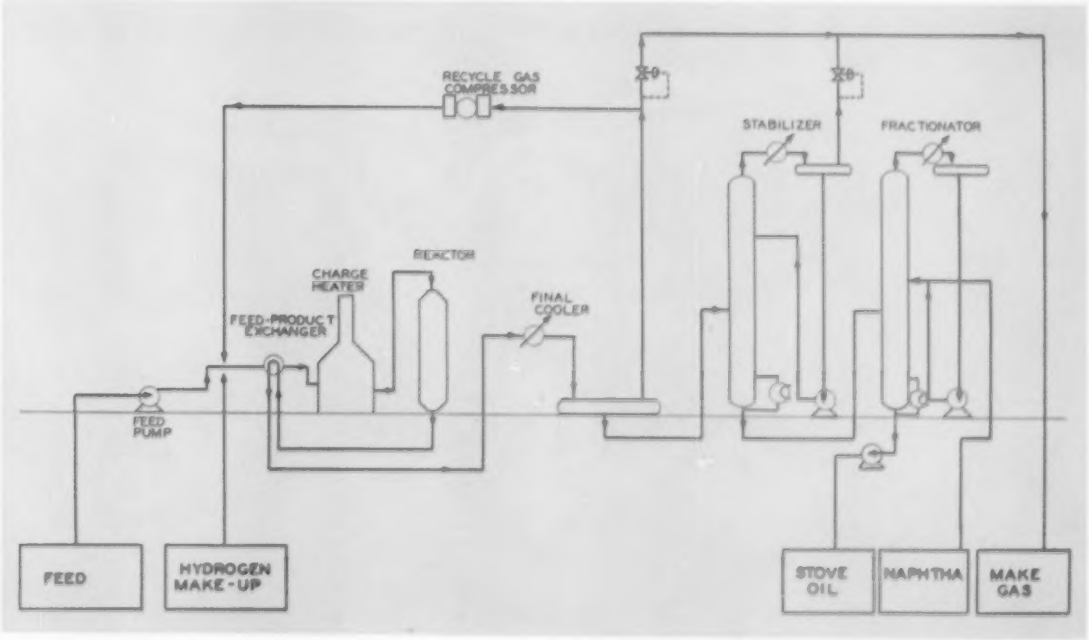
TABLE 1—UNIFINING THERMAL AND CATALYTIC NAPHTHAS

	Texas thermal naphtha	
	Charge	Product
Gravity, °A.P.I.	56.1	57.3
Doctor test	Sour	Sweet
Sulfur, weight per cent	0.21	0.05
Bromine number	83	52
A.S.T.M. gum, mg. per 100 ml.	17	2
A.S.T.M. octane number (D908, research method):		
Without TEL addition	65.0	60.6
With addition of 3 ml. TEL/gal.	77.6	77.9
A.S.T.M. octane number (D375, motor method):		
Without TEL addition	58.0	57.0
With addition of 3 ml. TEL/gal.	70.0	73.6
Liquid yield, volume per cent:		
Stabilized rerun gasoline		100.4
Rerun bottoms		0.5

TABLE 2—UNIFINING MID-CONTINENT HEAVY CYCLE OIL

	Charge	Product
Liquid yield, volume per cent		103.7
Gravity, °A.P.I.	26.5	32.1
Sulfur, weight per cent	0.47	0.07
Bromine number	16	9
Aromatics plus olefins, volume per cent	38.4	29.1
Gasoline in product, volume per cent		4.9
Fluid catalytic cracking of 400°+ F. fractions:		
C_5 to 400° F. gasoline, volume per cent	28.7	36.4
Conversion, volume per cent	47.8	48.5
Carbon on catalyst, weight per cent of cracking charge	6.7	2.1
Gasoline-to-carbon ratio	4.3	17.3

	Gasoline	Cycle oil	Gasoline	Cycle oil
Gravity, °A.P.I.	60.2	22.1	60.2	27.5
Sulfur, weight per cent	0.08		0.07	



HYDROGEN TREATING (Sinclair)

THE hydrodesulfurization process of Sinclair Refining Co. is based upon a cobalt-molybdenum on alumina catalyst developed jointly with the National Aluminate Corp. with which manufacturing arrangements have been made. This high-activity catalyst readily converts all types of sulfur compounds to hydrogen sulfide. Other impurities such as nitrogen and oxygenated compounds are removed or substantially reduced. The net effect is to produce a stock that is essentially free of compounds which cause corrosion, bad odors, and poor storage stability.

In operation at Sinclair's Marcus Hook, Pa., refinery is a 10,000-bbl. per day unit designed to desulfurize catalytic fluid light cycle oil. Sulfur is reduced from 1.0 to less than 0.1 per cent. Desulfurized cycle oil is blended with virgin heating oil to produce a low-sulfur, storage-stable stock that can be stored over the summer months. This adds flexibility to refinery operations and tends to level out characteristic peak production during the winter months.

Other units planned or under construction at Sinclair's Marcus Hook and Houston refineries will reduce the sulfur, nitrogen, oxygen, and metals content of straightrun naphthas for further processing in catalytic reforming units.

A simplified flow diagram of the fluid cycle oil desulfurization unit located at Marcus Hook is shown. Regeneration is accomplished by combustion of catalyst deposits with a controlled quantity of air mixed with superheated steam.

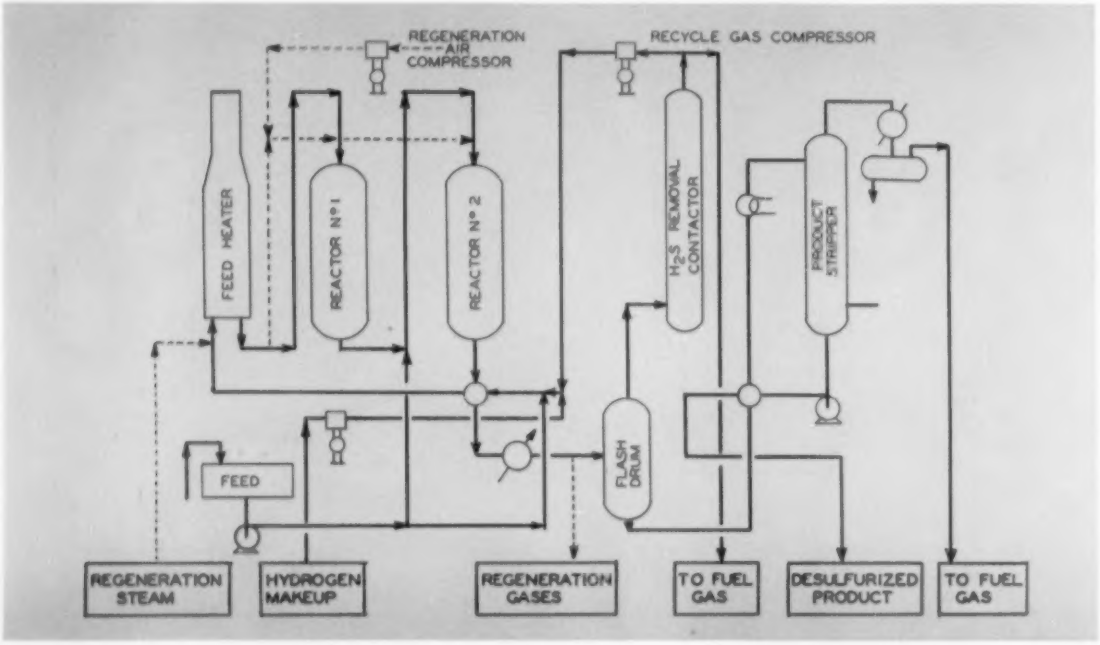
Important operating variables are temperature, pressure, hydrogen recycle, and space velocity. Temperature ranges from 580°-780° F. depending upon the stock and degree of desulfurization desired. Reactor temperatures are gradually raised to compensate for loss in catalyst activity. Pressure ranges from 200 to 800 psi. Most Sinclair units are designed to operate at 500 psig. Stocks containing a high percentage of nitrogen respond better to higher pressures of about 700 psig.

Hydrogen recycle ratio ranges from 2,000-5,000 standard cubic feet per barrel of feed. In general space velocity ranges from 2.0 on high-sulfur cycle oils to 8.0 on straightrun naphthas. The higher-boiling stocks containing complex sulfur compounds require low space velocities but the less-complex sulfur compounds contained in naphthas are readily reduced to acceptable levels at much higher space velocities.

Unique methods of manufacturing RD-154 worked out with National Aluminate Corp. yield of rugged extruded catalyst with excellent attrition properties and high surface area. Bench-scale and pilot-plant results indicate long cycle and total life for this catalyst.

Typical feed and product inspections when desulfurizing cycle oil and catalytic reformer feed stock are shown below.

	Blend California straightrun and visbroken naphthas		Fluid light cycle oil	
	Feed	Product	Feed	Product
Gravity, °A.P.I.	50.0	51.0	24.9	27.8
Sulfur, weight per cent	0.306	0.001	1.00	0.07
Bromine number	15.9	0.1	23.6	10.3
Nitrogen, weight per cent	0.006	0.000	0.036	0.025
Arsenic, p.p.b.	10	4		
Lead, p.p.b.	100	3		
Color, Saybolt (N.P.A.)	-10	30+	(1½)	(2)



HYDROFINING

THE Hydrofining process utilizes byproduct hydrogen from catalytic reforming to upgrade a wide variety of petroleum products and intermediate processing streams. It is a mild form of hydrotreating which produces volumetric yields of 100 per cent. While operating conditions vary widely depending on the feed stock and the desired degree of treating, they are not normally severe, ranging from 400° to 800° F. and 50 to 800 psig.

A Hydrofining unit affords continuous operation with relatively simple equipment comprising a feed preheat furnace, a fixed-bed reactor, gas-compression and separation facilities, and a stripper.

The process will upgrade poor-quality stocks previously considered unattractive for processing. It entails no disposal problem of waste products, since the principal byproduct, hydrogen sulfide, can be readily converted to sulfur.

Naphtha treating . . . Virgin naphthas are being Hydrofined to reduce sulfur from 0.12 to 0.01 per cent or lower, giving leaded octane improvement up to 10 numbers. Sulfur reduction to as low as 1 p.p.m. has been demonstrated for platinum-catalyst reforming feeds.

Both catalytic and thermal cracked naphthas can be processed for desulfurization and stability and engine-cleanliness improvements. Catalytic naphthas are substantially improved, with little or no loss in leaded octane, while some thermal naphthas may even show an increase in leaded octane.

Middle distillates . . . Heavy gas oils, both virgin and cracked, can be Hydrofined under moderately severe conditions to make higher-quality catalytic cracking feeds. As a result of the desulfurization, such feeds show a 4 to 5 per cent higher gasoline yield on catalytic cracking.

A variety of catalysts are available for the Hydrofining process. Cobalt and molybdenum oxides on alumina are used for some purposes, while other metal oxides have proved superior for other operations. Regeneration is possible if necessary, and catalyst life ranges from 6 to 12 months.

The Hydrofining process was developed by Esso Research & Engineering Co., licensors. Currently 33 projects with total capacity of some 291,800 bbl. are in the design stage, under construction, or operating.

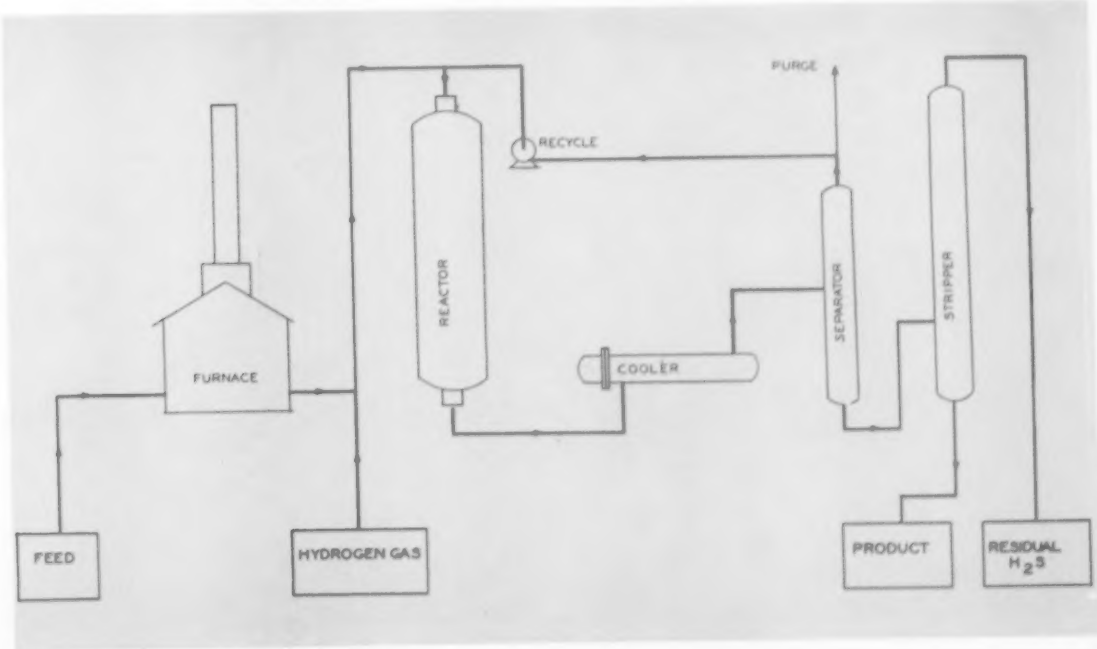
TABLE 1—HYDROFINING OF CRACKED NAPHTHAS

	Heavy cat. naphtha, 250°-442° F. e.p.	
	Feed	Hydrofining
Sulfur, weight per cent	0.24	0.07
Bromine number	23	17
General motor gum*	3	0.5/2.4
A.S.T.M. breakdown, min.	465	1,440+
FL-2 rating, per cent of reference†	96	77
C.F.R.R. octane:		
Clear	92.5	90.5
+ 2.0 ml. TEL	96.0	95.5
Yield, volume per cent		100

*Inhibited with 2 lb. per 5,000 gal. of phenylene-diamine type inhibitor. †Current commercial gasolines show an FL-2 rating of 70 per cent of reference fuel.

TABLE 2—HYDROFINING CAT CRACKER FEED STOCKS

Feed stock—	Raw	—Hydrofined—	
Conversion	48	48	55
Carbon, weight per cent	3.2	2.5	3.2
Naphtha inspections:			
Sulfur, weight per cent	0.27	0.04	0.04
Research octane numbers:			
Clear	93.0	93.6	94.3
+ 3 ml. TEL	97.0	98.4	98.9
Accelerated storage stability:			
+ 2 lb./5M gal. phenylene-diamine	1 wk.	3 wk.	
+ 5 lb./5M gal. phenylene-diamine	1 wk.	5+ wk.	



Shell Vapor-Phase Selective Hydrodesulfurization

SHELL OIL CO. has operated two selective vapor-phase hydrodesulfurization plants for nearly 10 years. The process employs a tungsten-nickel-sulfide catalyst at pressures from 500 to 750 psig.

Temperatures vary from 450° to 700° F. depending upon the feed and the condition of the catalyst. The operation is carried out in the vapor phase with low hydrogen-to-oil ratios.

The unit consists basically of an adiabatic reactor, a preheater, heat-exchange equipment, flash tanks for separating gas and products, compressors for recycling hydrogen, and treaters for removing hydrogen sulfide from both the recycle gas and the liquid product.

Raw feed is first mixed with hydrogen and the combined stream is preheated by heat-exchange with reactor products and then in a furnace. From the furnace, the feed passes in vapor phase to the adiabatic reactor. Reactor product is heat-exchanged with cold feed and then cooled by heat-exchange with water.

Gas remaining after the cooling step is treated to remove hydrogen sulfide and then recirculated. Make-up hydrogen is added to the recycle hydrogen. Liquid product from the high-pressure separator is first flashed at a low pressure to partially remove dissolved gases and then treated to remove hydrogen sulfide. A final caustic and water wash removes last traces of H_2S.

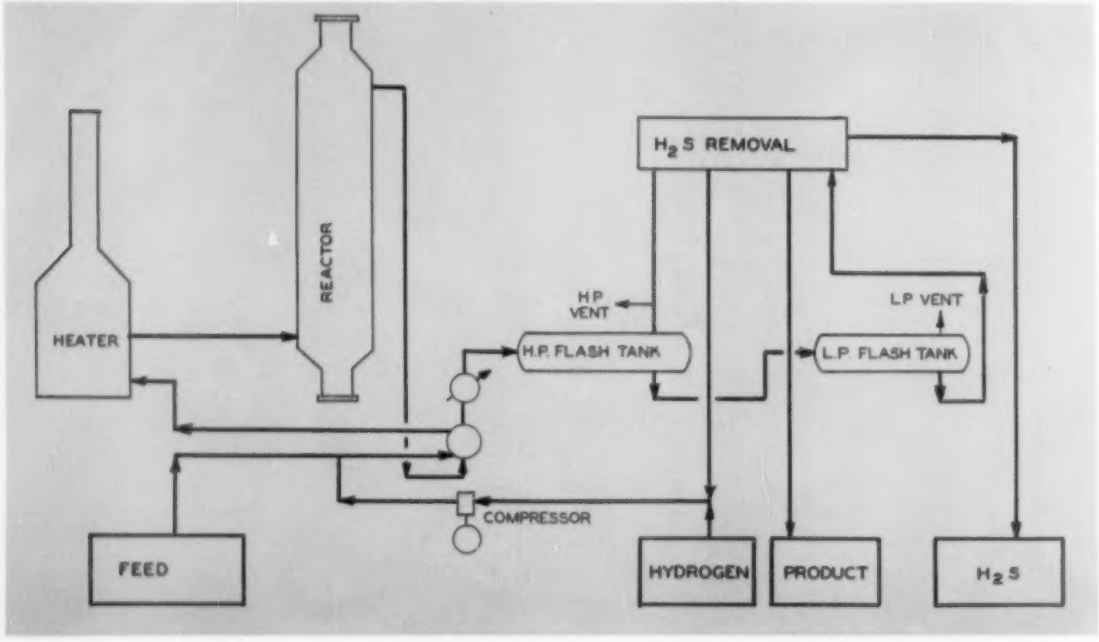
Table 1 shows feed and product properties before and after hydrodesulfurization of cracked naphthas.

A comparison of hydrodesulfurization costs with acid treating costs for a 9,300-bbl. per calendar day unit shows that the capital cost is $2,000,000 for hydrodesulfurization and $700,000 for acid treating. Total operating costs are $1,218 for hydrodesulfurization and $1,571 for acid treating. The 9,393 bbl. per day of product from hydrodesulfurization has a value of $57,861. The 8,713 bbl. per day of naphtha and 392 bbl. per day of cutter from acid-treating unit have a product value of $56,035. This leaves a net advantage for hydrodesulfurization of $2,179 per calendar day. Payout on total investment is 2½ years, while payout on incremental investment is 1.6 years.

Materials of construction for this type of plant should be adequate to resist the effects of hydrogen and hydrogen sulfide. Chromium and molybdenum in low concentrations are effective in preventing hydrogen damage that the pressures and temperatures use. Higher chromium steels may be required in certain parts of the plant to resist corrosive action by hydrogen sulfide.

TABLE 1—FEED AND PRODUCT PROPERTIES, SELECTIVE HYDRODESULFURIZATION OF CRACKED NAPHTHAS

Operation—	Aviation base stock		Motor fuel	
Feed	Catalytically cracked naphtha		Catalytically cracked naphtha	
Crude source	L. A. Basin		L. A. Basin	
Operation:				
Hydrogen consumed, s.c.f. per bbl.	500		110-175	
Length of process period before regeneration required, months	3-4		2-3	
	Feed	Prod.	Feed	Prod.
Yield and properties of feed and products:				
Liquid yields, vol. per cent	100	102	100	101
Total sulfur, vol. per cent	0.28	0.003	0.50	0.20
Mercaptan sulfur, wt. per cent	....	....	0.002	0.003
Bromine No., g. per 100 g.	72	9	45	33
MAV, mg. per g.	30	0.1	20	1.2
Aromatics, wt. per cent	33	33	41	41
A.S.T.M. gum, mg. per 100 ml.	....	1	3	1
Copper dish gum, mg. per 100 ml.	....	2	560	27
Induction period, hours	....	....	....	24+



HUSKY DIESULFORMING

PRIMARY purpose of Diesulforming is to reduce the sulfur content of the charge stock. However, the process also removes nitrogen and oxygen and provides additional advantages of color, odor, and cetane improvement.

The process is applicable to a wide range of petroleum fractions including gasolines and vacuum distillates, either cracked or straightrun, and of varying sulfur content. To date, the two commercial applications of Diesulforming are for high-sulfur straightrun distillate fuels.

The accompanying flow sheet shows the Diesulformer to be simple in design. These units are usually closely integrated with a catalytic reformer or other source of the hydrogen necessary for the treating reactions.

In this case the distillate feed stock and hydrogen recycle are first preheated by exchange with hot reactor effluent, then heated in a fired heater to the required reactor inlet temperature.

The charge passes down through a fixed-bed catalyst chamber where the desired reactions take place. After exchange with the charge, the reactor effluent is cooled before passing through the high-pressure separator where the liquid product is separated from the recycle gas which is recirculated by means of a compressor. Makeup hydrogen is introduced on the suction side of the compressor because this is the point of lowest pressure in the system.

The liquid effluent from the flash drum is stripped of hydrogen sulfide and any low-flash constituents. The bottom product from the stripper is a sweet desulfurized distillate that is ready for the market. A small volume of H_2S-saturated naphtha recovered from the stripper overhead which is in the gasoline boiling range is charged to the crude fractionator.

Catalyst . . . Catalyst activity has been remarkably good. Repeated regenerations are possible since the catalyst is extremely stable at 1,000° F., the regeneration temperature. The catalyst is expected to last indefinitely under normal operating conditions.

Temperature and space velocity are the important variables. Diesulfurization is directly proportional to the temperature and inversely proportional to the space velocity. Secondary variables such as pressure, purity of hydrogen, and recycle rate are interrelated.

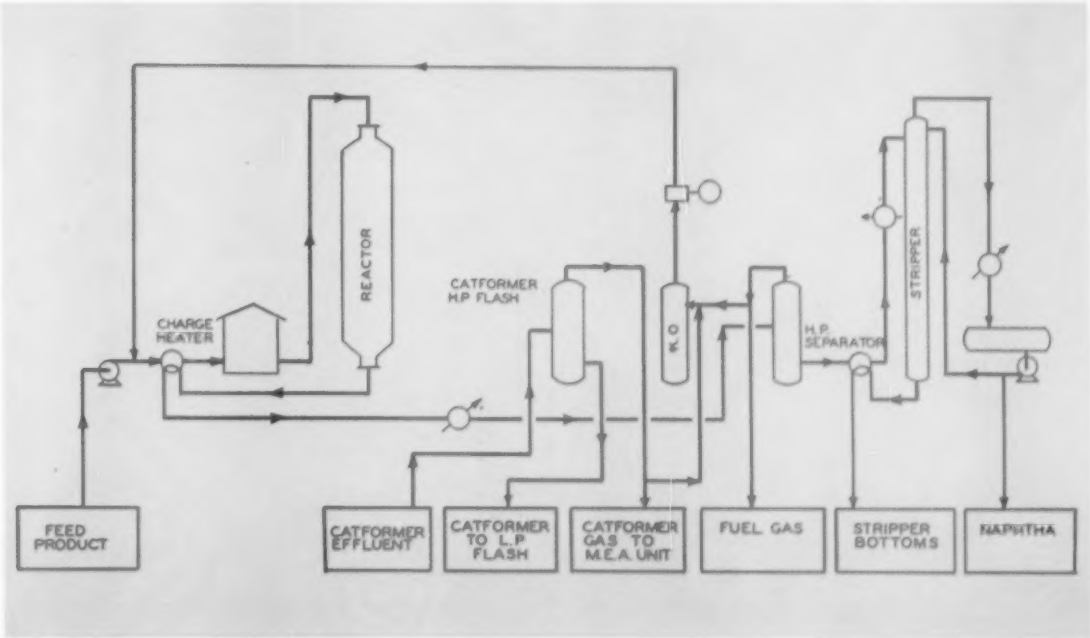
TABLE I—YIELDS AND OPERATING CONDITIONS

Operating conditions—	
Space velocity, lb. of oil per lb. of catalyst	1-2
Gas recycle rate, s.c.f./bbl.	5,000
Pressure, psi.	300-500
Temperature, °F.	600-800

	Medium dist.		Light dist.	
	Charge	Product	Charge	Product
Liquid yield, vol. per cent	100.0	100.1	100.0	100.2
H_2 consumption, s.c.f. bbl.		150		93
Per cent S total	2.2	0.35	1.02	0.105
A.P.I.	30.2	33.2	39.2	40.6
Distillation:				
I.b.p.	473	415	379	363
10 per cent	516	512	408	393
50 per cent	570	564	440	432
90 per cent	624	617	495	488
E.p.	656	658	533	545
Flash	230	152	154	147
Aniline point, °F.	142	152	136	143
Pour, °F.	5	5	—50	—50
Doctor			DNP	Pass
Odor	Poor	Good	Poor	Good
Cetane	48	52	45	47

Commercial Installations

The first commercial installation was made in the United States in 1953. The first Canadian unit went on stream in 1956. A license to use the Diesulforming may be procured from Husky Oil Co., Cody, Wyo.



AUTOFINING

AUTOFINING is a process developed by British Petroleum Co., Ltd., for the catalytic desulfurization of petroleum distillates. The main feature of the process is that hydrogen for the conversion of sulfur to hydrogen sulfide is obtained by controlled dehydrogenation of naphthenes present in the feed stock. No external hydrogen manufacture or byproduct hydrogen facilities are required.

Commercial units . . . The process can be applied to the desulfurization of all straightrun distillates up to 700° F. end point, aromatic extracts, and blends of straightrun and cracked distillates.

Three commercial units aggregating 7,500 bbl. per stream day capacity are at present operated by British Petroleum. One unit of 500-bbl. capacity desulfurizes kerosine sulfur dioxide extract for use as a high-octane-factor-fuel component while the other two units (each 3,500 bbl. per day capacity) operate on a tractor-fuel blend and give products requiring no further treatment before marketing.

Process . . . The feed stock and recycle gases are heated in the furnace to the reaction temperature, generally 750°-800° F. and passed into the reactor. Product flows to the accumulator where gas is separated and recycled, the liquid passing to the stabilizer for removal of hydrogen sulfide.

Space velocities of 2.0-5.0 v./v./hr. and pressures of 100-200 psig. are used. The normal recycle rate is 2,000 s.c.f./bbl. The process can be operated at constant pressure, in which case excess gas is vented from the accumulator, or at equilibrium pressure with no gas venting and a plant pressure of up to 500 psi.

The catalyst is of the mixed cobalt and molybdenum oxides on alumina type, and can be readily regenerated with steam/air or inert gas/air mixtures.

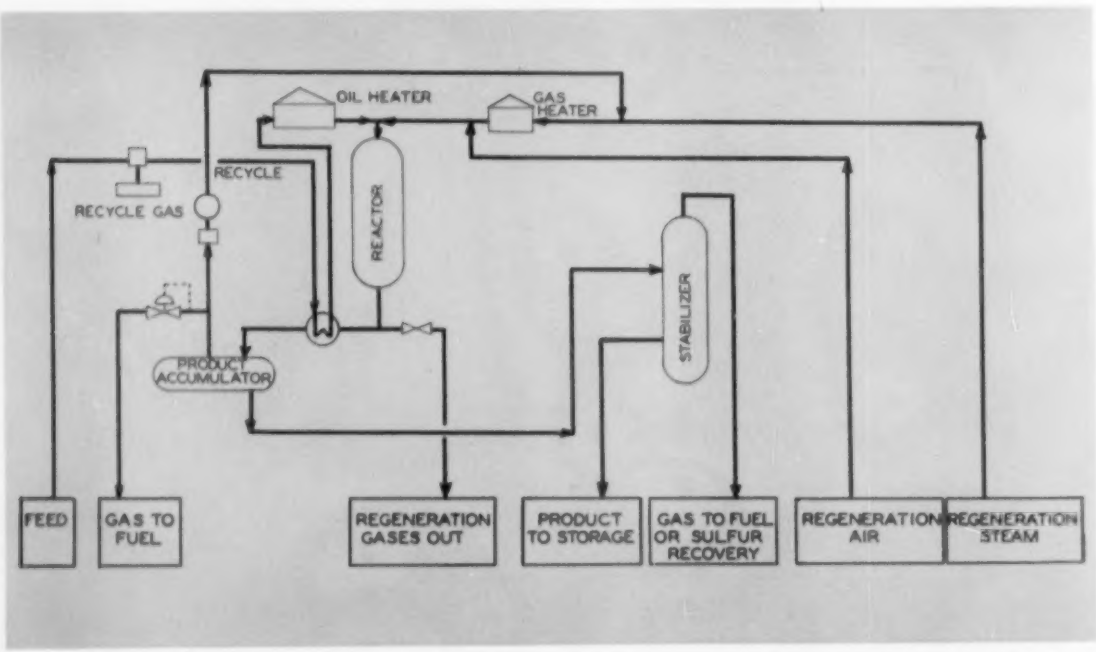
In addition to desulfurization, Autofining improves the octane number of gasolines and naphthas. A gasoline feed stock of 53 research octane number (75.3 with 2.9 ml. TEL) after Autofining gave a product of 81.3 research octane number with 2.9 ml. TEL.

An important application of the process is its use for desulfurizing catalytic reformer feed stocks (Table 1). The use of Autofining for this purpose makes available the maximum quantity of reformer hydrogen for the desulfurization of more refractory feed stocks.

Straightrun feed stock up to about 400° F. end point can be more or less completely desulfurized at space velocities of 5 vol./vol./hour. Desulfurization is accompanied by an increase in clear octane number of between two and three numbers and a greatly improved lead response. Another important application of the process is the treatment of naphtha feed stocks for production of solvents.

TABLE 1—CATALYTIC REFORMING OF AUTOFINED MIDDLE EAST NAPHTHA

	Catalytic reformate	
	From normal feed	From Autofined feed
Gravity, °A.P.I.	48.0	47.2
A.S.T.M. distillation, °F.:		
I.b.p.	120	122
10 per cent	180	181
50 per cent	306	312
90 per cent	367	371
E.p.	440	441
Total sulfur, per cent weight	0.012	0.006
A.S.T.M. octane number (D357 motor method) clear	81.8	82.5
A.S.T.M. octane number (D908 research method) clear	91.7	91.6
Yield C_4 free reformate, per cent weight	80.9	82.0
Hydrogen make, s.c.f./bbl.	278	336



Udex Extraction U.O.P.

THE Udex process utilizes solvent extraction to recover high-purity aromatics from their mixtures with other hydrocarbons. The process is capable of handling charge stocks of wide boiling range, such as a Platformate containing benzene, toluene, and xylenes, and with a minimum of utility consumption. It also may be used to produce high-purity products boiling above the C_9 aromatics.

The Udex solvent, diethylene glycol and water, has a high solubility for aromatics combined with good selectivity. It is very stable at temperatures in the operating range. The high-boiling point permits distilling the dissolved aromatics from it, rather than the reverse, thereby greatly reducing utility requirements. The two-component solvent permits adjusting selectivity and solubility to the optimum for the individual case, at the same time providing the necessary volatility to allow stripping at moderate temperatures and atmospheric pressure.

A simplified flow sheet of the process is shown. Essentially it consists of a countercurrent liquid-liquid extractor of unique design and a solvent stripper, with associated components for recovering and recycling the solvent. For simplicity, the fractionation section of one or more columns (e.g., there would be three in series to recover benzene, toluene and mixed xylenes from a single, wide-range feed stock) has been omitted.

The effectiveness of the Udex process is shown in Table 1, which gives typical results.

The products from Udex extraction are of extremely high purity. Nitration-grade benzene and toluene are routinely recovered from Udex extract by distillation without rerunning. (See Table 2.)

The Udex process was originated by the Dow Chemical Co. and is engineered and licensed by Universal Oil Products Co.

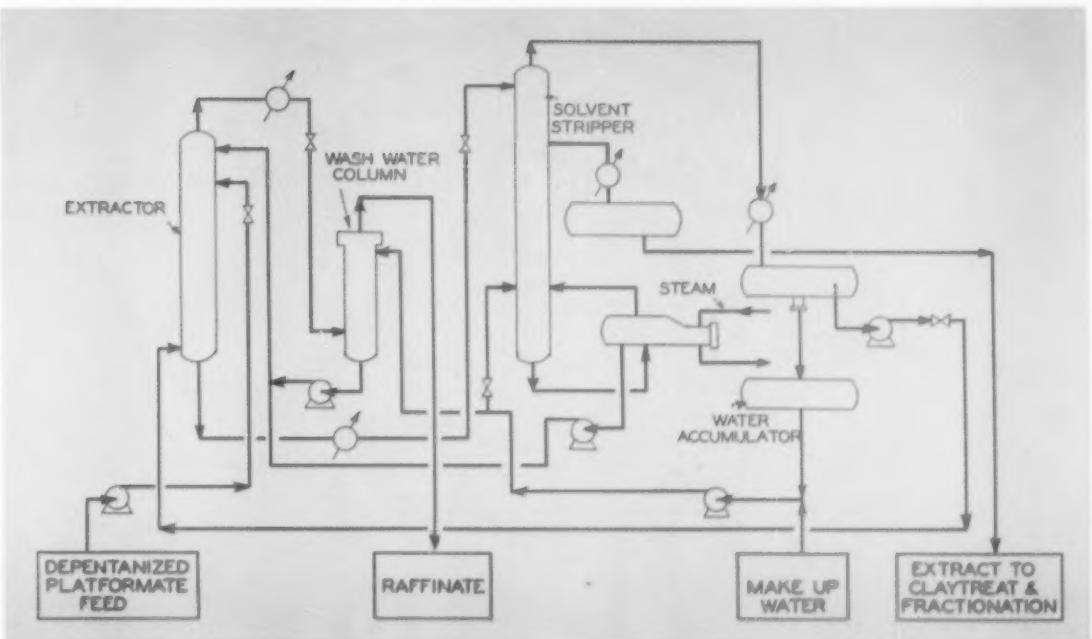
TABLE 1—RECOVERIES OF AROMATICS BY UDEX EXTRACTION

			Extract	
Component—	Feed composition (vol. %)	Raffinate composition (vol. %)	Products (B.p.s.d.)	Recoveries (vol. %)
Benzene	7.6	0.1	125	99.5
Toluene	21.5	0.9	348	98.0
Xylenes	21.0	2.0	330	95.0
C_9+ aromatics	1.9	0.5	25	80.0
Nonaromatics	48.7	96.6		
	100.7	100.1		

*1,650 bbl. per stream day charge rate.

TABLE 2—NITRATION GRADE AROMATICS SPECIFICATIONS VS. COMMERCIAL PURITIES

	Benzene		Toluene		Mixed xylenes	
	Nitration grade	Product	Nitration grade	Product	Nitration grade	Product
Sp. gr.	0.8820-0.8860	0.8849	0.8690-0.8730	0.8729	0.8650-0.8700	0.8718
Color	Water white	w.w.	w.w.	w.w.	w.w.	w.w.
Bromine index, A.S.T.M.		10		4		9
Acid wash color:						
Acid phase	2 (max.)	0	2 (max.)	0	6 (max.)	0
Hydrocarbon phase	0	0	0	−1	0	−1
Solidification point, °C.	4.85 (min.)	5.49	No spec.		No spec.	
Acidity, mg. NaOH/100 ml.	No free acid	Passes	No free acid	Passes	No free acid	Passes
Copper corrosion		Passes		Passes		Passes
H_2S and SO_2	None	Passes	None	Passes	None	Passes
100 ml. distillation, °C., range	(1 max.)	0.5	1 (max.)	0.5	3 (max.)	2.7
Paraffin, volume per cent		<0.1	1.5 (max.)	<0.2	4.0 (max.)	<0.2



Furfural Refining of Cycle Stocks

THE application of furfural refining to the cycle gas oils produced from catalytic cracking units, as well as to virgin gas oil cracking stocks, is a successful and versatile process. This is borne out by more than 6 years of plant experience.

A high yield of refined oil, having low-sulfur content and high cetane rating, can be recovered by furfural refining high-sulfur-content cycle oils.

Extraction of light cycle gas oil in variable combination with heavy cycle gas oil results in a high yield of refined oil having a low sulfur content. A.P.I. gravity is several degrees higher than that of the feed stock. By extraction metal contaminants as well as sulfur are removed from virgin cracking stocks and aromatics from heavy cycle gas oil, thus improving cracking operations, when either or both are charged to catalytic cracking.

Cat cracking of furfural-refined cycle stocks results in a product distribution comparable to that obtained in cracking the virgin gas oil of similar boiling range, from which the cycle stock was derived. Refined oil produces an equal total-butane-retention gasoline yield and more butane and less dry gas.

Product gasoline from cracking refined oil has lower sulfur content, higher octane rating, and lower average boiling point. Light cycle gas oil produced from refined oil has lower sulfur content and appreciably higher aniline point than that obtained cracking unrefined virgin gas oil.

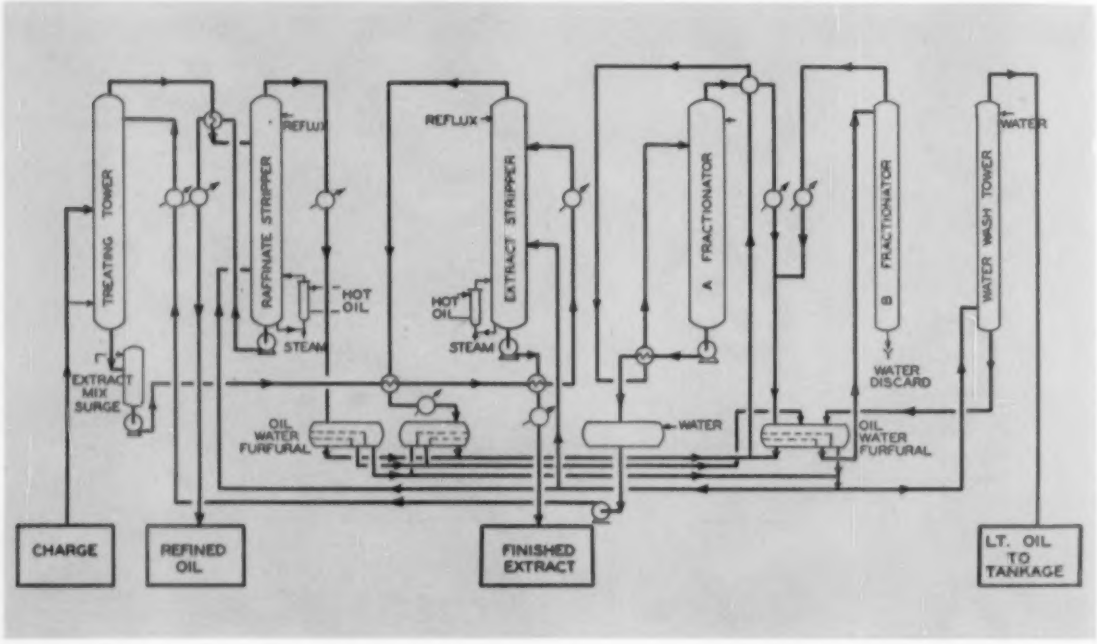
Some representative data showing result of refining cycle gas oils are presented in Table 1.

The furfural-refining process was developed by The Texas Co. and is licensed by Texaco Development Corp. Three units, with a capacity of 18,760 bbl. per day, are now being used for extraction of cat cycle stocks.

TABLE 1—FURFURAL REFINING OF CYCLE GAS OILS

	Light cycle oils							Mixed cycle oils				
Refined oil yield, vol. per cent charge from unit weight balance		71.1		75.8		79.3			67.9		65.3	
		Refined		Refined		Refined			Refined		Refined	
Steam quality—	Charge	oil	Extract	oil	Extract	oil	Extract	Charge	oil	Extract	oil	Extract
Gravity, °A.P.I.	31.4	41.6	10.5	39.8	10.0	38.2	10.1	24.5	36.3	4.5	38.1	3.7
Distillation, °F.:												
I.b.p.	484	485	500	478	502	483	500	480	484	494	481	495
10 per cent	505	504	510	500	517	503	512	506	505	517	503	519
50 per cent	528	528	534	525	538	527	534	557	546	606	544	608
90 per cent	567	570	582	565	589	567	590	749	724	*710	724	*708
End point	595	596	628	592	630	596	632	...	...	...	...	...
Viscosity-S.s.U. at 100° F.	36.1	36.5	37.5	36.4	37.6	36.3	37.6	42.9	40.1	61.9	40.3	62.4
Pour point, °F.	+5	+15	....	+10	....	+10	....	+10	+55	....	+50	....
Aniline point, °C.	59.1	80.7	....	75.6	....	73.4	....	60.7	79.8	....	83.0	....
Sulfur, wt. per cent	1.10	0.19	2.96	0.35	3.10	0.44	3.15	1.70	0.61	3.59	0.44	3.63
Cetane number	42.5	64.2	....	60.0	....	57.0	....	....	....	....	....	....

*A.S.T.M. distillation 70 per cent point.



DELAYED COKING

THE delayed coking process is an important refining step in the economics of processing heavy asphaltic crudes. The demand for distillate fuels continues to increase at a greater rate than that for residual fuels. Within the next 10 years it is estimated that the demand for distillate fuels will increase 25 per cent while the demand for residual fuels will remain substantially the same as at present.

This situation, plus the fact that the average refinery charge will include a higher proportion of heavy crude stocks, demands that more distillate fuel, per barrel of crude, be produced in the future. One of the methods by which this is being done on an increasing scale is by the delayed coking process.

Industry's appreciation of the trend is attested by the coking units now being installed, and others being projected, in the general area of the Gulf Coast and eastern seaboard. Heretofore this area has been able to satisfactorily dispose of all its Bunker C.

Other uses . . . In addition to its function in existing refining facilities the delayed coking process offers attractive payout possibilities in several less conventional operations. A good yield of a synthetic crude can be produced from extremely heavy crude sources which at the present time cannot be economically exploited.

Natural asphaltic deposits (for example, gilsonite) can be converted to usable light fuels plus high-grade electrode coke by delayed coking plus catalytic hydrogenation.

Yields . . . The tables of yield and product specifications and the delayed coker flow diagram illustrate an operation based on processing a heavy Mid-Continent vacuum residue. A significant feature of this operation is the 51.5 volume per cent yield of excellent gas oil for catalytic cracking obtained from a residue with an initial boiling point of 1,050° F. The olefins in the C_3-C_4 fraction of the wet gas can be processed by catalytic polymerization.

The specifications listed for debutanized gasoline were obtained on the finished gasoline after gas-plant absorption and stabilization of the wet gas and unstabilized gasoline as produced from the coker. While the octane value of this gasoline is low it can be blended with straightrun products for reforming.

Proper coker heater design will insure an excellent "on stream" factor for any charge stock.

Information on delayed coking may be obtained from Lummus Co., New York.

PRODUCT YIELD SUMMARY

Component—	Lb./hour	A.P.I.	B/SD	Weight per cent	Volume per cent
Wet gas	16,320			12.7	
Unstabilized gasoline	21,550	53.4	1,930	16.8	21.4
Gas oil	59,040	30.4	4,635	46.0	51.5
Coke	31,450			24.5	
Charge	128,360	13.0	9,000	100	100

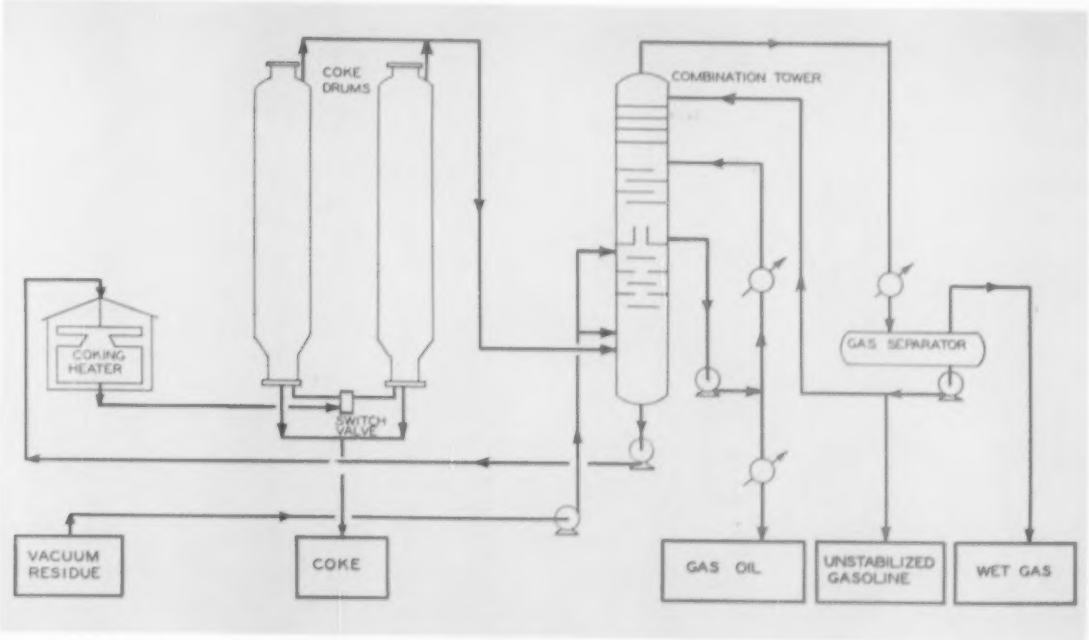
CHARGE AND PRODUCT SPECIFICATIONS

Charge Stock	
Gr., A.P.I.	13.0
Vis., S.F.s. at 210° F.	280
Con. Car., wt. per cent	14.1
I.b.p., °F.	1,050

Debutanized Gasoline	
Gr., °A.P.I.	60.0
R.v.p., psi.	4.0
Octane, clear	66.0
Dist. A.S.T.M., °F.:	
I.b.p.	116
10 per cent	165
50 per cent	265
90 per cent	355
E.p.	392

Wet Gas (mol. wt. = 31.9) (Mol. per cent)	
C_2, lighter	65.8
C_3's	19.1
C_4's	6.6
C_5+	8.5

Gas Oil	
Gr., A.P.I.	30.4
Con. Car., per cent wt.	0.10
Sulfur, per cent wt.	0.80
Dist., vac. corr'd to 760 mm.:	
I.b.p.	413
10 per cent	462
50 per cent	645
90 per cent	798
E.p.	850
Rec., per cent	98



FLUID COKING

THE fluid-coking process takes poor-grade crude residue as feed stock and converts it into valuable distillate products, along with byproduct gas and coke. The process was developed and is licensed by Esso Research & Engineering Co.

As shown in Table 1, residuum is completely reduced. Total distillate yields vary from 50 to 91.5 volume per cent, based on coker feed.

The naphtha fraction (C_5 to 430° F.) may be hydrogen treated to make prime feed stock for pentane-isomerization and/or catalytic-reforming processes, and thus may be converted into high-octane motor fuels. The gas-oil fraction (430° to 1,015° F.) may be used directly as a desirable feed stock for catalytic cracking into high-grade motor-fuel stocks.

Eight units, with a feed capacity of 114,650 bbl. per day, have been licensed thus far. The coke is currently being used as a fuel by a public utility and studies of other promising uses are under way.

An example of fluid-coking economics is given in Table 2.

TABLE 2—TYPICAL GULF COAST FLUID COKING ECONOMICS

(10,000 bbl. per stream day plant)

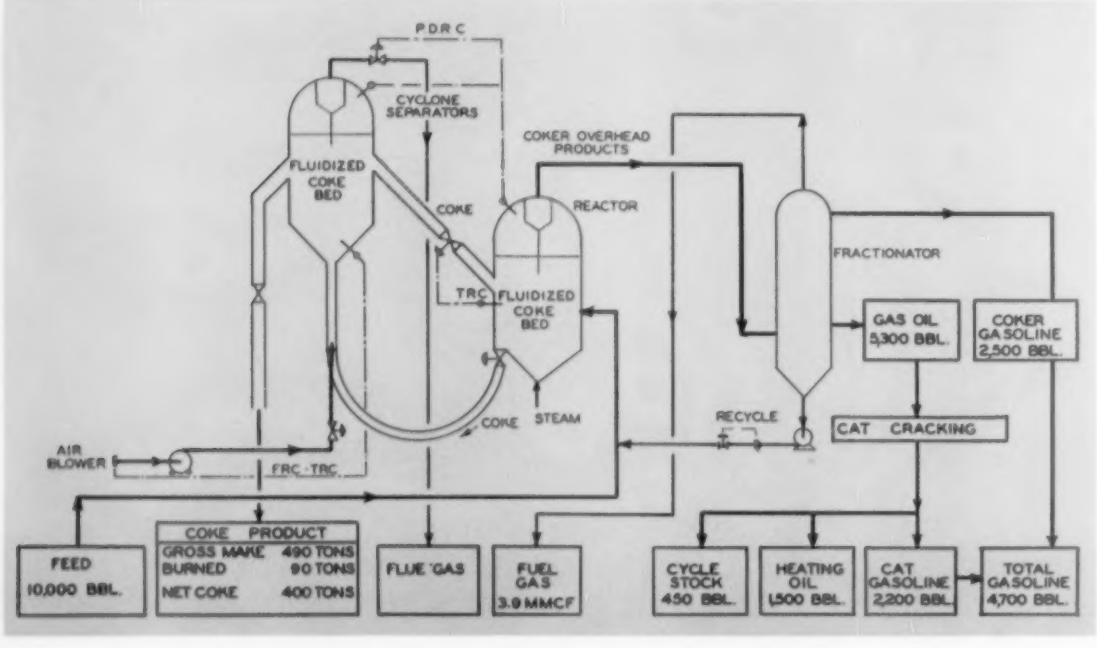
Crude source of vacuum pitch—	South Louisiana mixture	Hawkins
Yields on pitch:		
C_3°, wt. per cent	8	9.5
C_4-430, vol. per cent	24	23
430°-1,015°, vol. per cent	61	52
Coke, wt. per cent	16	27.5
Product value, per bbl. pitch:		
C_3°, at 90 cents per bbl. feed equiv.	$0.77	$0.09
C_4-430, at $3.20 bbl.	0.77	0.74
430°-1,015°, So. La. at $2.70 per bbl.; Hawkins at $2.00 per bbl.	1.65	1.04
Coke, at $5.00 per ton	0.14	0.25
	$2.63	$2.12
Feed value, per bbl.	$1.25	$0.75
Value added, per bbl.	1.38	1.37
Operating cost, per bbl. pitch*	0.24	0.24
Gross profit, per bbl. pitch	$1.14	$1.13
Coker investment, per B/CD	$235	$250
Return before taxes,* per cent per year on B.L. inv.	175	165
Return after 55 per cent income taxes*	80	75

*Excluding royalty.

TABLE 1—FLUID-COKING YIELDS

Feed source crude or feed stock—	Panhandle*	West Texas*	Coleville*	Ordonez*	Virgin pitch†	Asphalt†	Visbreaker tar†
Feed inspections:							
Gravity, °A.P.I.	17.3	8.4	3.7	2.5	6.7	—0.2	—3.5
Conradson carbon, wt. per cent	11	19	21	24	17	33	41
Sulfur, wt. per cent					2.0	2.3	2.1
H/C atomic ratio	1.71	1.53	1.42	1.43			
Per cent distilled at 1,000° F.					25	0	5
Ultimate yields:							
C_3° gas, wt. per cent	7	9	9.5	9.5	8	10	11.5
C_4, vol. per cent	2	3	3	3	2.5	3	3
C_5-430° F. naphtha, vol. per cent	21	21.5	20	20	16.5	17.5	14.5
430°-1,015° F. gas oil, vol. per cent	68.5	58	54	49.5	61.5	44.5	32.5
Coke, wt. per cent (gross)	11.5	19.5	24	30	20.5	36	48.5

*Vacuum residua from indicated crude. †Los Angeles Basin residual stock.



POLYMERIZATION

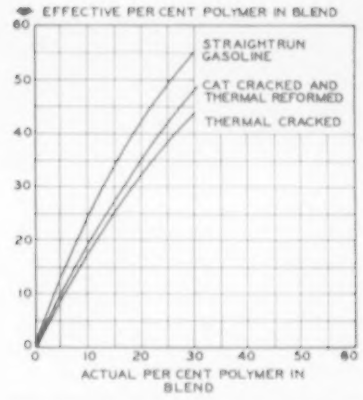
THE polymerization process of California Research Corp. produces a gasoline blending stock of high octane rating and blending value from propylene and butylenes. The reaction takes place in fixed-bed vessels at a pressure of about 500 psi. and temperatures from 275°-375° F. Usual design is for an average 90 per cent conversion of the olefins in the feed. Sulfur and nitrogen compounds are catalyst poisons and are removed from the plant feed by caustic and water scrubbing. The catalyst consists of a thin film of phosphoric acid distributed over fine-mesh quartz.

Preparation of the catalyst is simple. Reactors are packed with fine-mesh quartz and then filled with phosphoric acid. Acid is allowed to drain off leaving a thin film of phosphoric acid on the quartz. To regenerate the catalyst, a reactor is washed with water, steamed, and dried in place, then again recoated with phosphoric acid.

The polymers produced by the California polymerization process have a 94.5 to 100 F-1 clear octane rating and an even higher blending knock rating. In the concentrations usually employed, the effective concentration is 1.5-2.0 times the actual.

Leaded polymers exhibit the same general characteristics when blended with leaded base stocks, provided the sulfur and lead contents of the base stocks are at the level of the polymer. Characteristics of the polymer can be influenced by operating conditions.

The first large-scale plant was built in 1937 at the Richmond refinery of Standard Oil Co. of California. There are now 27 plants in operation and using the process and 11 plants under construction. Total design polymer production exceeds 30,000 bbl. per day.

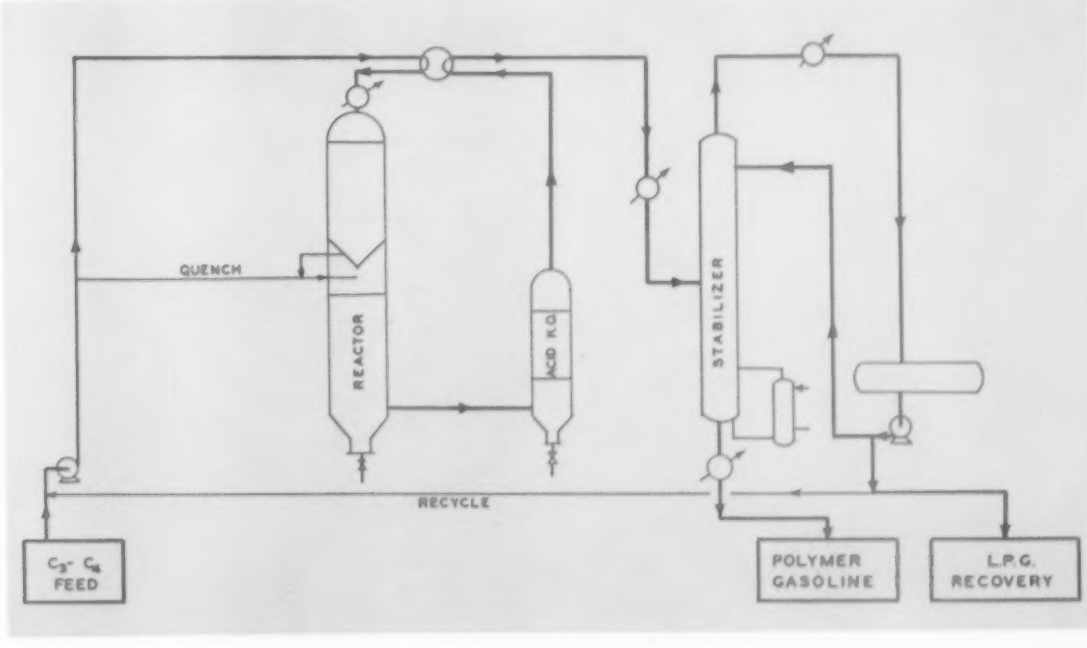


OCTANE-BLENDING BEHAVIOR of polymer in terms of effective concentration vs. actual concentration in motor gasoline stocks.

TABLE I—INSPECTIONS OF TYPICAL POLYMER GASOLINES

	Propene* polymer	Propene-butene* polymer
Gravity, °A.P.I.	57.1	63.0
Sulfur, per cent	<0.01	<0.01
Reid vapor pressure, psi.	0.8	2.6
Octane number:		
F-1 clear	94.5	96.0
F-1 + 3 ml. TEL	99.5	100.0
A.S.T.M. distillation, °F.:		
I.b.p.	180	130
10 per cent	251	215
50 per cent	305	252
90 per cent	390	365
E.p.	453	440

*Debutanized.



Phosphoric Acid Condensation

THE great expansion of the petrochemical industry has added tremendously to the uses of the U.O.P. solid phosphoric acid catalyst. It is well recognized as an outstanding catalyst for producing high-octane motor fuel from refinery butylenes and propylene. It also is an important polymerization catalyst for the production of valuable chemical polymers such as tetramer, C_6-C_9-C_{15} olefins for the production of alcohols and sulfonates, and as an alkylation catalyst for the production of cumene, ethyl benzene, secondary butyl benzene, diisopropyl benzene.

Chamber units . . . Recent advances in engineering have reduced the capital costs and increased the efficiency of the chamber-type polymerization units such that there are now more chamber-type units being designed than the "reactor" or tubular type of unit. It is these chamber-type units that are now being widely used in the petroleum field.

The products now being produced or under consideration for these units are tetramer, cumene, ethyl benzene, secondary butyl benzene, diisopropyl benzene, and C_6-C_9-C_{15} olefins for the production of alcohols and sulfonates.

Products . . . The flow chart shows a polymerization unit for C_3-C_4 motor polymer. A rerun column is added when producing tetramer or alkyl aromatics such as cumene on this unit. Tetramer is the basic material for the alkyl aryl sulfonate type of detergent and cumene is now used as a basic material for the production of phenol and acetone.

The hydrocarbon charge is mixed with water and passed into the catalyst chamber. Reaction conditions are controlled here by means of a propane quench. Reactor effluent passes to a depropanizer and propane product, propane for recycle, and quench propane are taken off the top of this column.

Yields normally correspond to 90-97 wt.-per cent of olefins converted to motor polymer when charging C_3-C_4 olefins from thermal and catalytic cracking. Properties af some of the products are shown in the table.

In the production of tetramer from propylene motor polymer and tetramer bottoms also are produced. The motor polymer yield varies from 1 to 25 liquid volume per cent and the bottoms yield from 2-4 liquid volume per cent of the total polymer produced. These percentages vary because of the various tetramer specifications.

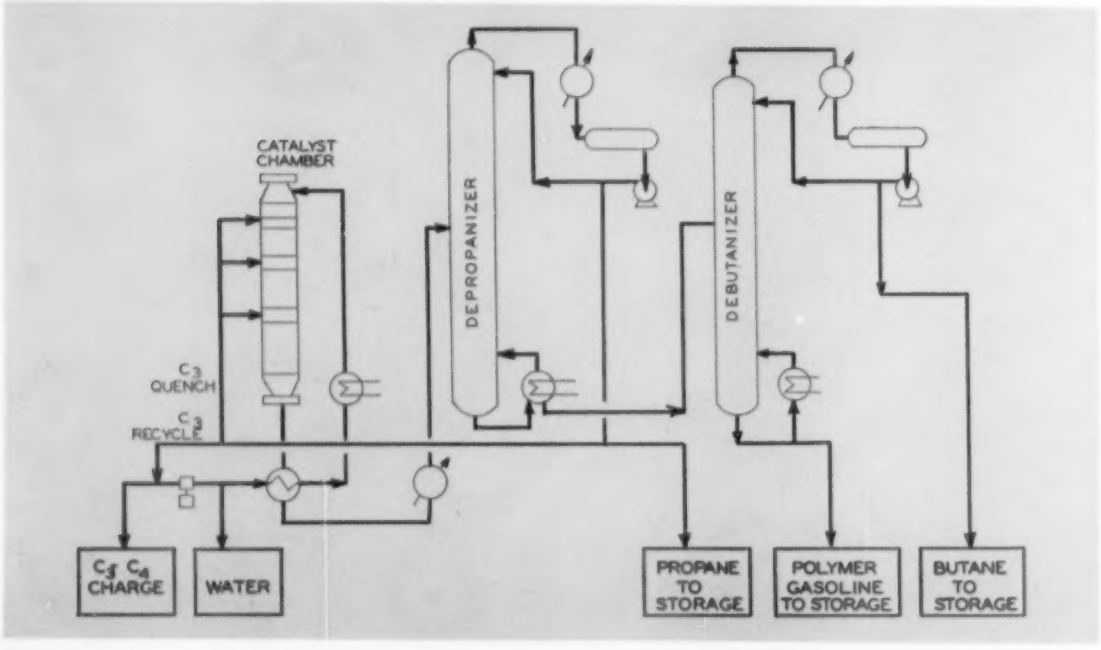
When cumene is produced, approximately 96 vol.-per cent of the propylene and benzene feed is yielded as cumene; the remainder, 4 per cent as heavier aromatics, constitutes rerun bottoms.

This process is licensed by Universal Oil Products Co.

PROPERTIES OF PRODUCTS

	C_3 Motor Polymer	C_3-C_4 Polymer	Tetramer	Cumene
R.v.p.	4.4	9.2	0.0	0.0
Gravity, °A.P.I.	59.5	66.1	51.0	32.1
A.S.T.M. Engler dist.:				A.S.T.M. aromatic dist.
I.b.p.	136	96	353	301
5 per cent		130		302
10 per cent	228	149	361	302
30 per cent	258	201		302.5
50 per cent	276	228	371	303
70 per cent	292	263		303
90 per cent	338	348	397	303
E.p.	420	422	450	*304
Research octane with 3 ml. TEL	99.5	100		

*Dry point.



HF ALKYLATION U.O.P.

THE HF alkylation process is a catalytic method of reacting isobutane with propylene, butylenes, amylenes, or higher-boiling olefins or mixtures of olefins from thermal or catalytic cracking, to form a highly branched paraffinic product of excellent antiknock properties and tetraethyl lead susceptibility for use as a blending component in aviation gasoline or motor fuel. Butylenes, or butylenes-plus-propylene are the most common olefin charging stocks.

Hydrogen fluoride or HF alkylation is especially applicable in a refinery where additional isobutane charge and low-boiling materials required for gasoline vapor pressure can be obtained at low cost from sources other than cracking, thereby permitting the use of all the low-boiling olefins as charging stock for the production of alkylate acid consumption is no higher for propylene or, amylenes than for the butylenes. Twenty-eight 100-octane HF alkylation plants were operated during World War II for the production of aviation gasoline. Later operation of some of these units to manufacture motor gasoline has demonstrated that with low acid costs and no acid-disposal problem, the process is a very good method for making the 100-plus octane which soon may be required for premium motor fuel.

The HF alkylation process shown schematically in the flow diagram above is arranged for the production of motor-fuel alkylate.

In aviation-gasoline production a rerun column, bauxite towers, a debutanizer, and a depropanizer also would be required. Marked improvements have been made recently to simplify design and thereby lower capital and operating costs both in the aviation and motor-gasoline alkylation units. A lower catalyst inventory is required than formerly and plant arrangement and control have been simplified. The contactor has been reduced and acid-circulation pumps have been eliminated, the regenerator has been simplified with provisions for improving the purity of the regenerated HF, and the fractionation section rearranged to reduce utility requirements.

Isobutane and requirements, yields, and product qualities are shown in Table 1.

Analytical data and antiknock rating interrelationship for a rerun butylene alkylate are shown in Table 2.

Optimum processing arrangement and conditions must be determined for each installation. Installation costs for motor alkylate plants run approximately $500 per barrel in sizes down to 500 bbl. per stream day of 3.5-lb. R.v.p. product.

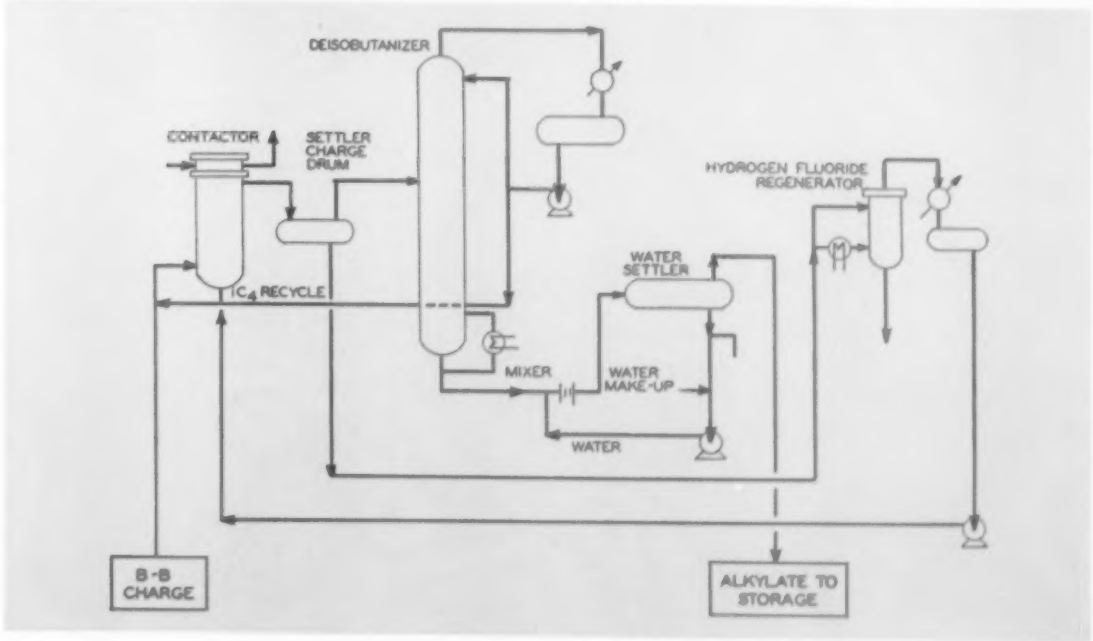
This process is licensed by Universal Oil Products Co.

TABLE 1

	Vol./Vol. Olefin		F-2 Octane No.		F-2 Octane No.	
	Isobutane	Alkylate	Clear	+ 3 cc. TEL	Clear	+ 3 cc. TEL
Butylenes	1.16	1.72	92-95+	102-106	92-94	100-101
Propylene	1.50	1.75	90-91	100-104	89-90	99-103

TABLE 2

Gravity, °A.P.I.	70.7
Reid vapor pressure, psi.	3.5
Isopentane content, vol.-per cent	4.3
Total alkylate, vol.-per cent	94.7
Engler distillation, °F.	
I.b.p.	148
10 per cent	197
50 per cent	218
90 per cent	226
E.p.	247
Antiknock ratings with 4.6 ml. TEL/gal.	
F-3, Octane number	106.7
F-3, Performance number	131.6
F-4, Iso C_8 + ml. TEL	3.64
F-4, Performance number	150.6



Effluent Refrigeration Alkylation

THE octane race and improvements in the alkylation processes have gradually shifted the interest in alkylation to motor fuel until today most new plants are being designed primarily for motor-fuel production.

One of the major improvements in the alkylation process which has led to this shift in the interest to motor fuel is the effluent refrigeration process. By this process alkylate can be made economically so that its use in motor fuel may be justified, and with the same plant and process the alkylate required for aviation gasoline of the highest quality may be made.

First effluent refrigeration unit to be designed and built was that of The Texas Co. at Amarillo, Tex. This unit started operation early in 1954 and the operation of six other units has been started since that time. Five units are under construction and many others are under consideration.

Lower costs . . . Effluent refrigeration applied to the sulfuric acid alkylation process results in lower capital investment, decreased operating costs, increased yield, higher-quality alkylate, and lower acid consumption. Effluent refrigeration is essentially a means of economically obtaining a very high isobutane concentration in the reaction mixture with little conventional fractionation. The hydrocarbon portion of the reaction mixture or hydrocarbon effluent from the reactor after separation in the settler becomes the refrigerant used in the cooling elements of the reactor, and hence the term effluent refrigeration.

The most important variable in the alkylation of isobutane with olefins is the isobutane-to-olefin ratio or the related concentration of isobutane in the reaction mixture. Although a high ratio or a high concentration of isobutane may be obtained by conventional fractionation this is a relatively expensive method. The same result is accomplished in a much more economical manner by the use of effluent refrigeration which puts the heat of reaction to work in building up isobutane recycle.

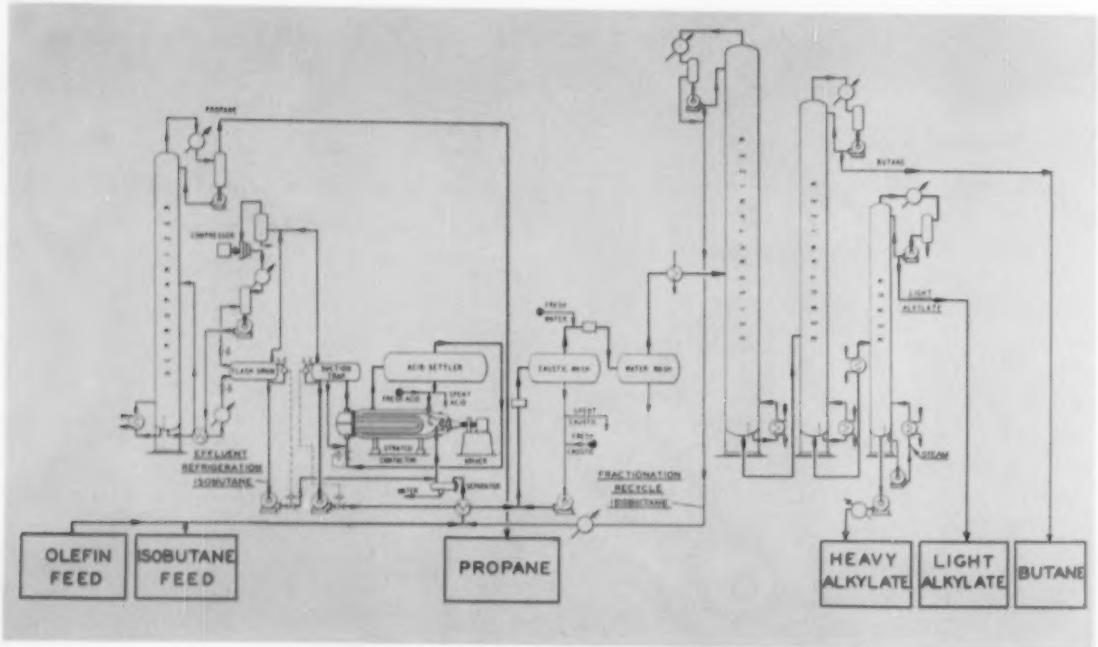
As a practical matter it becomes economical to operate with an isobutane to olefin ratio of 8 or 9, or an isobutane concentration as high as 75 per cent in the hydrocarbon portion of the reaction mixture, whereas the attainment of these figures by conventional fractionation cannot usually be justified from an economic standpoint.

Process Description

The acid-hydrocarbon mixture leaving the contactor is passed to the settler where it is separated into an acid phase which is returned to the contactor and a hydrocarbon phase which leaves the top of the settler. The hydrocarbon effluent passes the back-pressure regulator, is reduced in pressure, and thereby self-cooled to about 20° F. by partial vaporization of its isobutane component. The resulting cooled effluent is routed through the cooling coils within the contactor. The cooling elements of the contactor are kept flooded with a recycle of cold liquid from the suction trap.

The vapors, which are largely isobutane, are disengaged from the liquid in the suction trap, passed to the compressor, and condensed. After depropanization, the condensate is sent to the flash drum where cooling to about 18° F. is accomplished by vaporization of a portion of the condensate. The cold liquid leaving the suction trap is heat-exchanged with the incoming fresh acid, neutralized, and passed to the deisobutanizer.

The overhead from the deisobutanizer and the isobutane obtained from the effluent refrigeration recycle (bottom stream from flash drum) constitute the total isobutane recycled to the reaction zone. Of the total isobutane recycled usually one-half to two-thirds is supplied by the effluent refrigeration recycle and only



one-third to one-half by the deisobutanizer. The feed stock for one plant under construction has an isobutane-to-olefin ratio in the feed of 2.54 with the result that 100 per cent of the isobutane recycle will be furnished by the effluent refrigeration recycle. A deisobutanizer is not being installed.

In the effluent refrigeration system none of the isobutane is allowed to vaporize from the reaction mass in the contactor. Thus the total amount of isobutane from the effluent refrigeration recycle is present in liquid phase throughout the entire reaction zone and contributes to increasing the concentration of isobutane in the same manner as though it had come from a deisobutanizer.

Flash drum . . . In the present design of the system a refrigerant flash drum is included. This provides an attractive means of direct refrigeration of the refrigerant recycle stream down to 20° F. or lower, and also provides a means of increasing the concentration of propane in the refrigeration condensate without building up the propane content of the hydrocarbon liquid in the reaction zone.

Efficient propane elimination may be easily accomplished with the flash drum in units operated on a mixed propylene-butylene feed or on an olefin feed made up entirely of propylene. In this system the reaction pressure for propylene alkylation or for mixed propylene-butylene alkylation is only slightly higher than for butylene alkylation.

Amylene feeds also may be readily handled without difficulty.

Reactor system . . . The contactors used are of the new horizontal design using a U-tube heat exchanger. Very efficient heat transfer is obtained, resulting in a small cooling-surface requirement. Reactors of this design result in economies of installation and maintenance.

Catalyst consumption . . . The catalyst consumption depends upon a number of factors such as the composition of the feed stocks; amount of impurities in the feed stocks, such as water, butadiene, and sulfur compounds, and the operating conditions. However, under favorable operating conditions the consumption of sulfuric acid may be as low as ¼ lb. of acid per gallon of alkylate, and under most commercial conditions encountered the consumption for butylene alkylation would not be expected to be over 0.4 lb. per gallon.

Results

The analyses of feed stocks which are typical of plants being designed, constructed, and operated are shown in Table 1. Alkylation units in the design stage vary in size from a few hundred barrels up to 7,500 bbl. per stream day. Interest in propylene alkylation has increased greatly because of the interest in alkylation for motor-fuel production, and also because it can be effectively handled with effluent refrigeration. Typical results which have been obtained from a commercial plant operating on butylenes are shown in Table 2.

Note in Tables 2 and 3 the high quality of the alkylates. For either butylene alkylates or mixed propylene-butylene alkylates the end point of the total alkylate should be under 400° F., so that if desired, the entire alkylate may be used in motor fuel as far as the end point is concerned.

The clean-burning property, resistance to surface ignition, and high lead susceptibility make the high-quality alkylates produced ideal for blending in motor fuel, as well as for aviation gasoline. The performance number with 4.6 cc. TEL of the aviation alkylate from a commercial plant averaged over a period of about 9 months was 155.4.

Information about the effluent refrigeration alkylation process may be obtained from Stratford Engineering Co., Kansas City, Mo.

TABLE 1—TYPICAL FRESH FEED

	Volume per cent	
	Butylenes	Mixed propylene-butylenes
Ethylene		0.04
Ethane		0.14
Propylene	0.09	11.10
Propane	0.11	11.30
Isobutane	40.14	33.85
Butylenes	34.56	16.27
n-Butane	22.51	25.58
Isopentane	2.24	1.50
C_5 olefins		0.17
n-Pentane		0.05
Hexanes plus	0.35	
	100.00	100.00

TABLE 2—TYPICAL BUTYLENE ALKYLATION

Operating conditions:	
Temperature, °F.	43.5
Isobutane in reaction mixture	68.5
Conc. of spent acid, weight per cent H_2SO_4	90.0
Space velocity (gal. per hr. olefin/gal. acid in reactor)	0.40
Total debutanized alkylate:	
I.b.p.	114
10 per cent	167
20 per cent	186
50 per cent	215
90 per cent	255
E.p.	382
C.F.R.R. (F-1) clear	95.0
C.F.R.R. 3 cc. TEL	Isooctane + 0.74 cc. TEL
Aviation alkylate:	
Per cent of total alkylate	*94.9
I.b.p.	116
10 per cent	164
20 per cent	182
50 per cent	213
90 per cent	252
E.p.	306
1C Performance No. 4.6 cc. TEL	125.0
3C Performance No. 4.6 cc. TEL (Supercharged F-4)	157.5
Heavy alkylate or bottoms:	
Per cent of total alkylate	5.1
I.b.p.	340
10 per cent	345
20 per cent	347
50 per cent	352
90 per cent	400
E.p.	485
C.F.R.R. clear	84.0
C.F.R.R. 3 cc. TEL	97.0

*96-98 per cent for aviation alkylate of 338° F. e.p.

TABLE 3—TYPICAL YIELD AND QUALITY DATA

Debutanized total alkylate:	Butylenes	Mixed propylene-butylenes*
E.p., °F.	375-400	375-400
C.F.R.R. (F-1) clear	94-96	93-95
C.F.R.R. 3 cc. TEL	Isooctane + 0.4 cc. TEL / Isooctane + 1.0 cc. TEL	100-Isooctane + 0.5 cc. TEL
Aviation alkylate:		
Per cent of total alkylate	96-98	92-97
E.p., °F.	338	338
C.F.R.R. (F-1) clear	95-97	92-95
C.F.R.R. 3 cc. TEL	100-Isooctane + 1.2 cc. TEL	100-Isooctane + 0.8 cc. TEL
1C Performance No. 4.6 cc. TEL	120-130	115-122
3C Performance No. 4.6 cc. TEL (Supercharged) F-4	152-165	146-152

*Approximately 40 per cent propylene—60 per cent butylenes.

Aluminum Chloride ALKYLATION

THIS is a liquid phase catalytic process to convert normally gaseous hydrocarbons to high-octane motor fuel. Ethylene, propylene, and isobutane are the charge stocks. The product is a clean-burning, high-octane motor-fuel alkylate.

The basic reaction of the aluminum chloride alkylation process is the reaction of ethylene and propylene with isobutane to produce a high-quality product boiling in the gasoline range. The catalyst employed is aluminum chloride in a complex with hydrocarbons. HCl is used as a promoter and is produced by injecting a controlled amount of water into the reactors.

Dry fresh feed consisting of ethylene, propylene, and isobutane are charged to the reactor. Catalyst is added intermittently to the system by passing the isobutane charge through a catalyst makeup drum. The reactor effluent passes through a primary settler for phase separation of hydrocarbon and catalyst. The catalyst is recirculated to the primary reactor. The smaller portion of hydrocarbon from the primary settler passes to a secondary settler for final removal of any entrained catalyst. A major portion of the effluent hydrocarbon from the primary settler is recycled through a cooler to the first reactor to maintain the desired temperature of the second reactor. The reactors normally operate at fairly constant temperature. The hydrocarbon effluent from the secondary settler is caustic washed before entering the fractionation section.

The fractionation section consists of a depropanizer, deisobutanizer and alkylate splitter. Propane and lighter hydrocarbons are yielded as an overhead gas from the depropanizer, isobutane is yielded overhead from the deisobutanizer and recycled to the reactors, the motor fuel alkylate is fractionated for end point in the alkylate splitter.

Information about aluminum-chloride alkylation may be obtained from Phillips Petroleum Co., Bartlesville, Okla.

TYPICAL OLEFIN FEED ANALYSIS

Component—	Mol %	Component—	Mol %
Methane	12.5	Propane	2.7
Ethylene	45.2	Butane	0.7
Ethane	15.8		
Propylene	23.2	Total	100.0

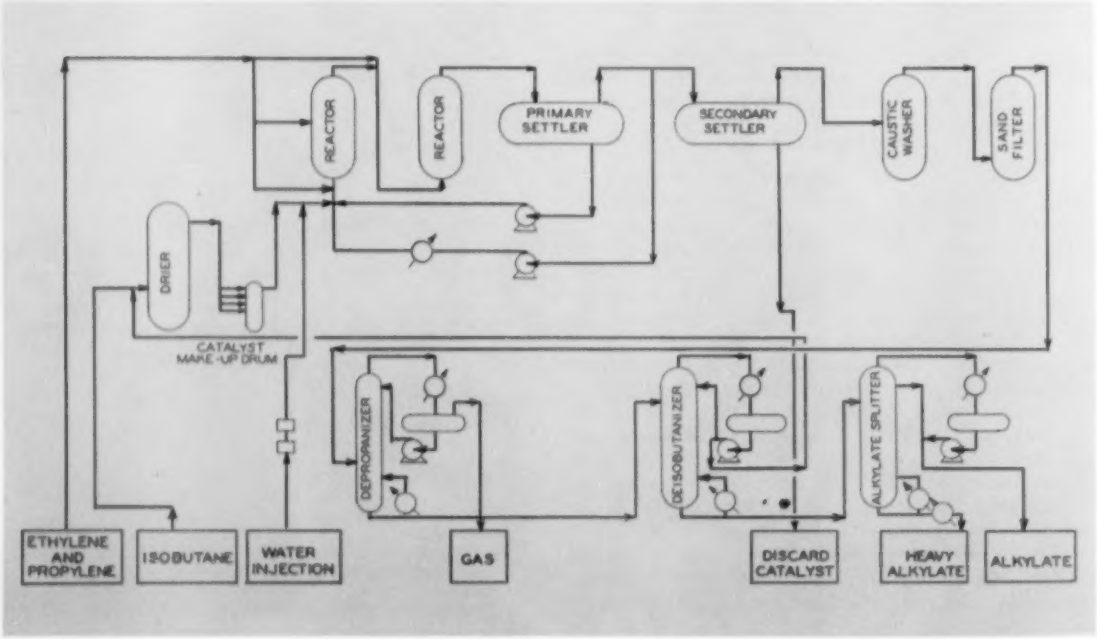
TYPICAL PROPERTIES OF MOTOR-FUEL ALKYLATE

Per cent of total alkylate	95.0
R.v.p. (undebutanized)	9.0
°A.P.I.	74.0
A.S.T.M. distillation, °F.:	
I.b.p.	110
10 per cent	129
20 per cent	140
50 per cent	159
90 per cent	300
95 per cent	363
E.p.	425
A.S.T.M. research octane number:	
Clear, 0 ml. TEL	59.1
1 ml. TEL	*102.7
3 ml. TEL	†109.5

*Equivalent of A.S.T.M. research method rating of 0.15 ml. TEL in isooctane. †Equivalent of A.S.T.M. research method rating of 1.10 ml. TEL in isooctane.

REPRESENTATIVE COST FIGURES

Utilities—	Unit/bbl. total alkylate
Steam (million B.t.u. absorbed)	0.44
Cooling-water circulation, 1,000 gal., 20° rise	2.6
Makeup water, 1,000 gal.	0.08
Power, kw.-hr.	3.3
Chemicals—	
Caustic, lb.	0.015
Aluminum chloride, lb.	2.80



PERCO HF ALKYLATION

THE alkylation of isobutane with olefins such as propylenes, butylenes, or amylenes, using hydrofluoric acid as a catalyst, is a well-established process for producing high-octane-number blending components used in aviation gasoline and motor fuels. Until recently, due to government regulation, most alkylate was utilized in aviation-gasoline rather than motor-fuel blending. With these restrictions removed, and with the ever-increasing demand for higher octane and quality, more and more alkylate will be used in motor fuel.

Essential features of the Perco HF alkylation process are shown in the flow diagram.

As an auxiliary to the operation, an acid rerun unit is provided, where the hydrofluoric acid catalyst is continuously purified by the fractionation of a small portion of the circulating acid stream. The acid-soluble oil production is so small that it can be easily disposed of.

Former Expense Eliminated

Caustic washing is the only treatment employed on motor-fuel alkylate, thus eliminating the former expense of catalytic defluorination. An infrared analyzer records continuously the isobutane content of the recycle isobutane and motor-fuel alkylate. Use of the infrared analyzer results in considerable reduction of isobutane losses to motor fuel and improves alkylate quality by maintaining high-purity isobutane recycle.

The on-stream factor for the modernized Perco HF alkylation unit is approximately 98 per cent. Units are currently operated continuously and trouble-free for periods of 18 to 24 months between turnarounds.

This process is licensed by Phillips Petroleum Co.

Tables 1-3 show typical operating data, cost data, and product properties.

TABLE 1—TYPICAL OPERATION OF HF ALKYLATION
(Based on 100 bbl. per day total feed)

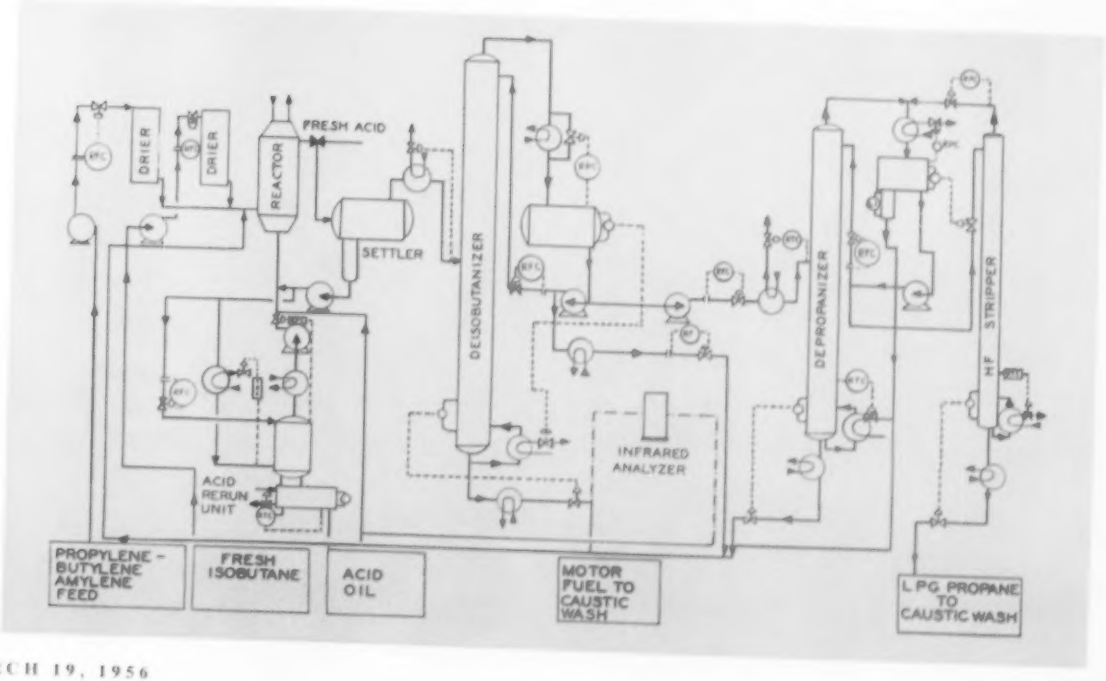
	Bbl.
Charge to unit:	
C_3 fraction from cat cracker:	
Propane	0.9
Propylene	0.9
Butylenes	32.5
Isobutane	40.2
n-Butane	25.5
Total unit feed	100.0
Yields from unit:	
Propane	0.9
Isobutane	1.1
n-Butane	25.5
Alkylate	56.8
Total yield	84.3

TABLE 2—TYPICAL PROPERTIES, DEBUTANIZED MOTOR-FUEL ALKYLATE

Gravity, °A.P.I.	68.8
A.S.T.M. distillation, °F.	
I.b.p.	160
50 per cent evap.	224
End point	392
A.S.T.M. research octane number:	
+0 ml. TEL	93.1
+1 ml. TEL	100.8
+3 ml. TEL	104.9

TABLE 3—SUMMARY OF DIRECT OPERATING EXPENSE, 98 PER CENT STREAM FACTOR

	Dollars per bbl. alky.
Operating labor	0.0800
Supervision and laboratory	0.0800
Repair labor and materials	0.1600
Utilities	0.1240
Chemicals	0.0660
Total	0.5100



SULFURIC ACID ALKYLATION

Kellogg

ALKYLATION is gaining considerable attention as a process for producing high-octane blending stocks for motor gasoline.

The present trend is toward the production of motor fuels with a narrower spread between research and motor octane numbers. This puts renewed emphasis on isoparaffins as motor gasoline components, and particularly points up the advantages of alkylate.

Basically, sulfuric acid alkylation is a low-temperature process which employs a concentrated sulfuric acid catalyst to combine olefins such as propylene, butylenes, or pentenes with isobutane.

The process has many advantages over catalytic polymerization because:

1. Isobutane as well as olefins are converted, resulting in an increased product yield.
2. Alkylate is essentially free of gum-forming materials so that additives are not required.
3. Alkylate has a higher tetraethyl lead response.
4. Performance in supercharged engines is superior to catalytic polymerization gasoline.

In Cascade alkylation units, developed and licensed by M. W. Kellogg Co., isobutane is reacted with olefins to form saturated isoparaffins in the presence of sulfuric acid catalyst. Propylene, butylene, and amylene olefins are converted either individually or in mixtures, and are combined with the isobutane in a highly agitated emulsion in which the continuous phase is sulfuric acid catalyst.

Operating features . . . The diagram illustrates the schematic flow through a typical alkylation unit, which has resulted in lower plant investment, improved operating cost, and superior-quality alkylate.

Olefin-bearing liquid feed is cooled to about 35° to 45° F. and contacted with an excess quantity of isobutane and acid catalyst in the reactor at 5 to 15 psig. The olefin feed is split into equal streams and charged to each reaction zone of the Cascade system. Isobutane-rich recycle and refrigerant streams are introduced into the first reaction zone and pass in series flow through successive zones to provide the necessary excess isobutane.

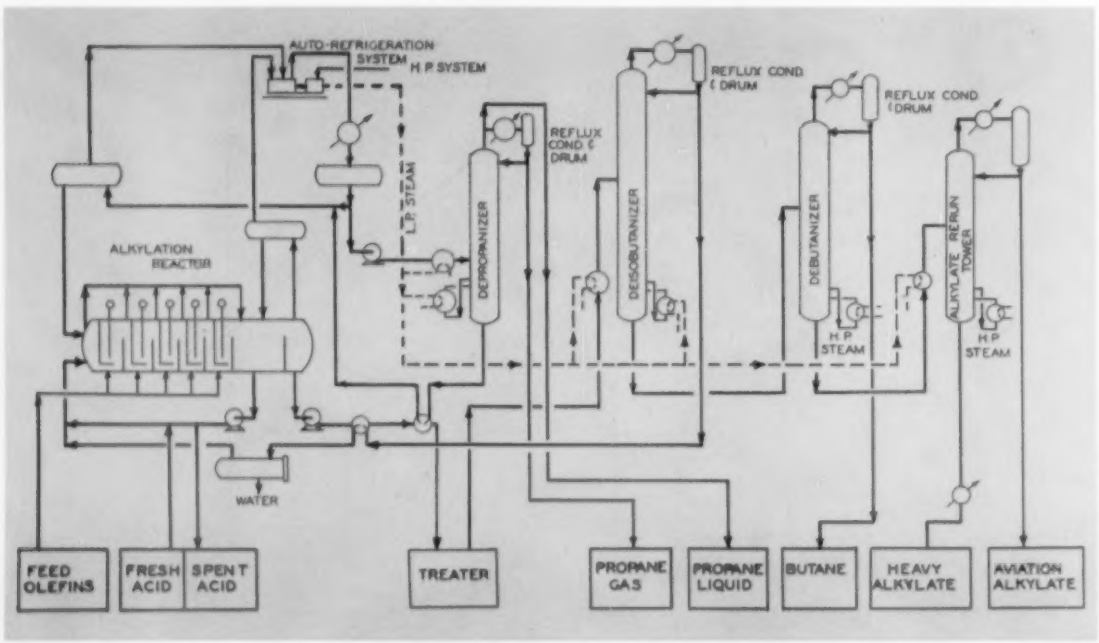
Reaction products, excess isobutane, and other diluents in the feed remaining in the liquid phase are separated from the acid in the settling zone and charged to fractionation equipment for separation of isobutane recycle and normal butane from the alkylate product. The heavy polymers produced are separated from the desirable alkylate in the rerun tower; isobutane is recycled to the head reaction zone of the reactor, and normal butane withdrawn to product storage.

Refrigerant vapor resulting from removal of heat of reaction, etc., is compressed, condensed, and the liquid returned to the head reaction zone. This refrigerant is predominantly isobutane; however, its propane content is higher than elsewhere in the process. A portion of this refrigerant is diverted to the depropanizer tower for removal of propane from the system.

Sulfuric acid catalyst is recirculated through the reactor to stabilize the acid strength and as contaminants build up a portion of the circulating acid is withdrawn and replaced by high-purity sulfuric acid.

Acid consumption . . . Acid consumption accounts for the major operating cost in a sulfuric acid alkylation unit. There are, then a number of advantages which accrue if acid consumption can be reduced.

Commercial data show that acid consumption decreases in plants operating for high-quality alkylate product, and that acid consumption decreases as strength of charge acid increases. Figs. 1 and 2 show how acid consumption decreases as quality of alkylate prod-



uct is increased, when 100 per cent sulfuric acid is used as charge.

Linear interpolation may be used between Figs. 1 and 2, if mixed feed is used.

Treating system . . . A new reactor effluent treating system, which is an improvement over caustic-water effluent treating shown on the flow sheet, is now in use. More than 98 per cent of the sulfur from the reactor effluent stream is removed by the new method. This compares with approximately 65 per cent removal by the caustic-water system.

Advantages of the new system are (1) reduction in fractionator tower and reboiler fouling, (2) reduction in the use of inhibitors, and (3) substantial TEL savings.

Reactor design . . . The Kellogg Cascade reactor incorporates several features conducive to proper processing conditions for economic production of high quality alkylate, including:

1. The internal mixer and the undershot of L-baffle between compartments, which maintain proper fluid flow conditions for efficient olefin and isobutane contact with the sulfuric acid catalyst for maximum yield of alkylate and minimizing undesirable byproducts.

2. Heat-exchange surface and auxiliary refrigerants are not required since the heat of reaction is removed by autorefrigeration in vaporizing a portion of the hydrocarbon stream at the location of reaction, thus promoting isothermal operation.

3. Series flow of isobutane recycle, isobutane refrigerant and acid catalyst, and parallel flow of olefin feed create optimum reaction conditions of high isobutane concentration and high isobutane-olefin ratio, with a minimum flow of external isobutane recycle.

4. Isobutane concentration in reaction zones is considerably higher than in the effluent stream as a result of the refrigerant isobutane being present as a liquid in zones upstream of those from which it vaporizes.

5. Multicontactors with settling zones incorporated in the same vessel reduce the quantity of steel, etc., required and result in a lower installation cost.

Yield . . . Yield of alkylate from several typical feed streams are compared in Table 1 with respect to isobutane and acid consumption, along with typical octane ratings of alkylate rerun to aviation gasoline specifications. Higher acid consumption, lower aviation alkylate yields, and lower octane values are typical for operation where low isobutane-olefin ratios or low isobutane concentration are used in the reactor. Higher values are representative of operation where high isobutane concentration conditions are maintained for maximum quality product.

TABLE 1—TYPICAL ALKYLATION YIELD DATA

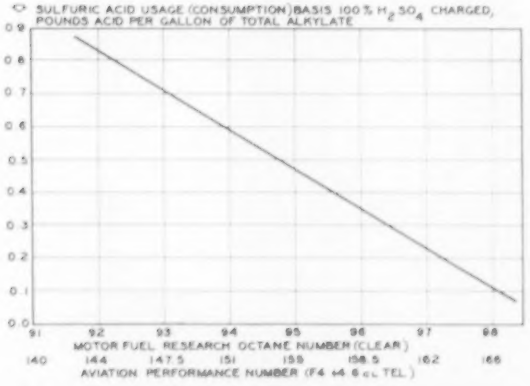
Olefin feed type—	Propylene	Propylene-butylene‡	Butylene	Amylene
Yield (vol. per cent on olefins):*				
Total alkylate	178	174	172	160
Aviation alkylate (338° F. e.p.)	150-160	156-162	153-165	140-149
Isobutane consumption:				
Gal. iC_4 per gal. olefin	1.275	1.17	1.106	0.965
Acid consumption:				
Pounds 98 per cent H_2SO_4 per gal.	1.8-2.0	1.0-1.3	0.4-0.6	1.0
Aviation alkylate quality:				
Research Oct. No.:				
Clear	89-92	93-95	94-97	92-93
3.0 cc. TEL	101.6-103	103.5-104.9	104.2-106.2	103-103.7
A.S.T.M. Oct. No.:				
Clear	87-90	91-93	92-95	90-92

*True alkylate—corrected for components in feed. †40 per cent. ‡60 per cent.

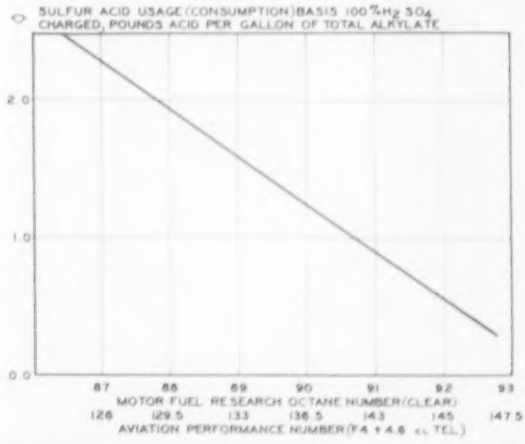
TABLE 2—COMPONENTIAL BREAKDOWNS OF TOTAL ALKYLATES

Components—	Boiling point (°F.)	F-4 index No. (4.0 cc. TEL)	LV%*	LV%†
2,3-Dimethyl butane	128	205	5.9	4.2
2,2-Dimethyl pentane	175	143		
2,4-Dimethyl pentane	177	83	4.3	3.3
3,3 and 2,3-Dimethyl pentane	194	140	9.5	2.2
2,2,4-Trimethyl pentane	211	154	31.9	30.4
Dimethyl hexane	233	44	1.1	5.9
2,3,3-Trimethyl pentane	230	225		
2,3,4-Trimethyl pentane	236	193	32.4	37.7
Isononanes	265-290		3.2	5.2
Isodecanes and heavier	295		11.7	11.1
Total			100.0	100.0

Types of alkylate produced: *25 per cent C_3, 75 per cent C_4. †3.5 per cent C_3, 90 per cent C_4, 6.5 per cent C_5.



ALKYLATE QUALITY INCREASES as acid consumption decreases, as shown by this curve for a typical butylene feed. Fig. 1.


SULFUR ACID USAGE (CONSUMPTION) BASIS 100% H_2SO_4 CHARGED, POUNDS ACID PER GALLON OF TOTAL ALKYLATE
2.0
1.0
0.0
87 88 89 90 91 92 93
MOTOR FUEL RESEARCH OCTANE NUMBER (CLEAR)
126 129.5 133 136.5 143 145 147.5
AVIATION PERFORMANCE NUMBER (F4 +4.6 cc. TEL)

DECREASE IN ACID CONSUMPTION is accompanied by an increase in alkylate quality. This curve is for typical propylene feed. Fig. 2.

ALKYLATION
Effluent Treating

REMOVAL of 99 per cent of acid and both acidic and neutral esters from alkylation reactor effluent is now possible. The new treating process, developed jointly by D-X Sunray Oil Co. and M. W. Kellogg Co., employs bauxite to adsorb the troublesome byproducts of sulfuric acid alkylation.

The first unit has successfully reduced corrosion and fouling in alkylate fractionating equipment and has improved lead susceptibility in motor alkylate by effective sulfur removal. The 98 to 99 per cent efficiency of this process compares with 65 per cent removal of sulfur obtained in the conventional caustic wash system.

Used With Coalescer

The new treating process is used in conjunction with a coalescer which provides the equivalent of added settling time in the alkylation unit. This horizontal vessel, packed with glass wool and steel mesh, performs an initial separation of suspended drops of acid and sulfur hydrocarbons.

The total effluent from the alkylation reactor is then charged alternately to the top of two treating towers. As it percolates downward through medium mesh bauxite, acid and esters are preferentially adsorbed.

Sample tests indicate when the stream should be switched to the regenerated bauxite in the alternate tower. Samples are taken at a point above the bottom of the bed to provide advance warning of adsorbent saturation.

Cycle life is about ¾ bbl. of effluent throughput per pound of bauxite. A charge of bauxite in this unit has been in use for an extended period of time and cumulative life is in excess of 150 bbl. per pound.

The treating process provides the only sure protection against these maintenance troubles. Table 1 summarizes the comparable efficiencies of bauxite treating and caustic wash systems.

Capital costs of the new treater are comparable to conventional caustic facilities. The economic evaluation of the two systems is shown in Table 2.

The alkylation effluent treating process is licensed by M. W. Kellogg Co. Design data are available in five standard sizes ranging from 5,000 to 25,000 bbl. per stream day of reactor effluent.

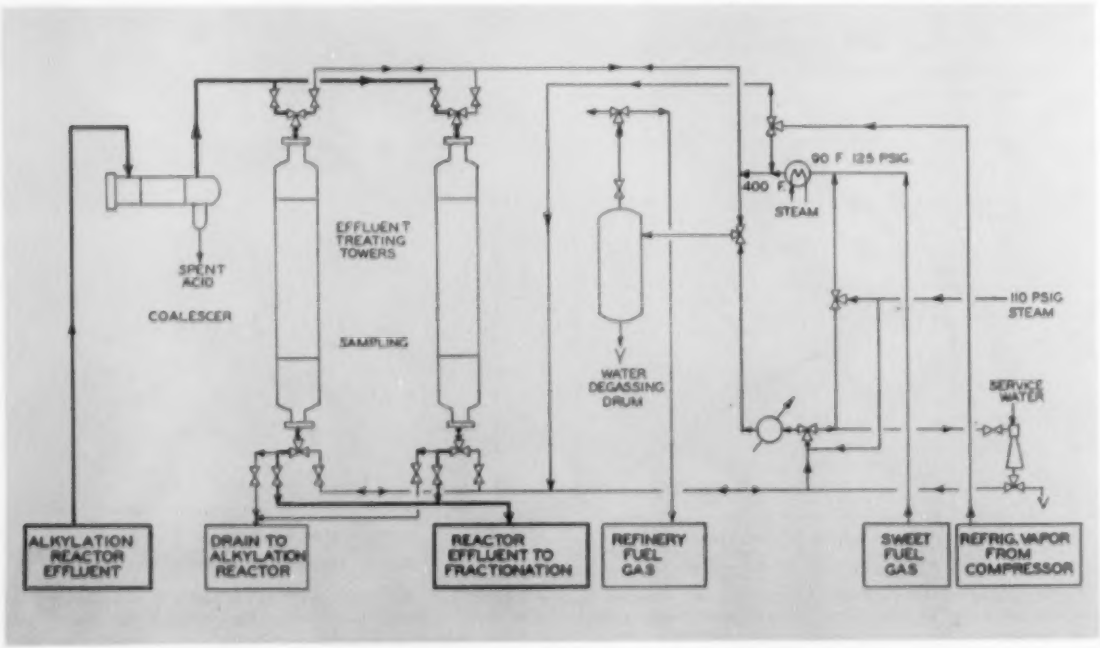
TABLE 1—COMPARISON OF EFFICIENCIES

	—Coalescer and caustic— Weight per cent sulfur	Per cent removal
Reactor effluent	0.127	0
Coalescer effluent	0.025	80
Caustic wash system	0.009	92.8
Bauxite treating unit	0.00037	99.71

TABLE 2—ECONOMIC EVALUATION OF BAUXITE TREATING INSTEAD OF CAUSTIC AND WATER WASHING

(Basis: 14,000 bbl. per stream day reactor effluent)

Item—	Quantity	Unit price	$/D
Credits:			
Caustic	450 lb./day	$0.05 lb.	22
Inhibitor (T.E.A.)	47 lb./day	0.24 lb.	11
Process water	147,000 gal./day	0.09/1,000 gal.	14
Acid cons. savings	1,480 lb./day	15 ton	11
TEL savings	0.15 cc./gal.	0.0023 cc.	73
Total			131
Debits:			
Process water	19,700 gal./day	$0.09/1,000 gal.	2
Cooling water	84,000 gal./day	0.009/1,000 gal.	1
Steam	22,000 lb./day	0.30/1,000 lb.	7
Bauxite	140 lb./day	0.05 lb.	7
Total			17



LIQUID-PHASE ISOMERIZATION

IN THE SHELL liquid-phase isomerization process, which is entirely continuous and nonregenerative, normal butane or normal pentane is contacted in the liquid state with a catalyst consisting of aluminum chloride dissolved in molten antimony trichloride.

Charging stock . . . Either butane or pentane may be converted to the corresponding isoparaffin in the same plant. The only additional equipment required for converting the C_5 hydrocarbon are the hydrogen compressor and its surge. The compressor can be eliminated, however, if a source of hydrogen at the desired pressure is available so that it can be used on a once-through basis.

The feed hydrocarbon is mixed with dry hydrogen chloride gas which acts as a catalyst promoter. In addition, when pentane is isomerized by this process, it is necessary to introduce a disproportionation suppressor such as hydrogen along with the HCl, as disproportionation reactions, if not controlled, would result in a low ultimate yield of isopentane and high catalyst consumption.

In operation, the normal paraffin is charged continuously, at approximately atmospheric temperature, to one of two driers. Temperature of the dried feed is raised to about 180° F., before entering a packed catalyst scrubber column. Here a small side stream of catalyst from the contactor is countercurrently extracted with the feed.

The valuable active catalyst components are returned to the contractor in solution. The essentially inactive $AlCl_3$-hydrocarbon complex, formed as a result of side reactions, settles to the bottom of the column and is periodically drawn off.

Equipment . . . The feed stream, containing recovered aluminum chloride and antimony trichloride, flows from the top of the catalyst scrubber column and is joined with recycle hydrogen chloride and, in the case of pentane isomerization, recycle hydrogen prior to entrance into the reaction vessel.

The contactor is a vertical autoclave fitted with a mixing device to effect intimate contact of catalyst and hydrocarbon. Period of contact is relatively short, the charge remaining 10 to 15 minutes in the contactor. A high average conversion is obtained; 45 per cent or better for butane and 55 per cent or better for pentane. Separation of the isomerate from the catalyst takes place in the baffled upper section of the contactor.

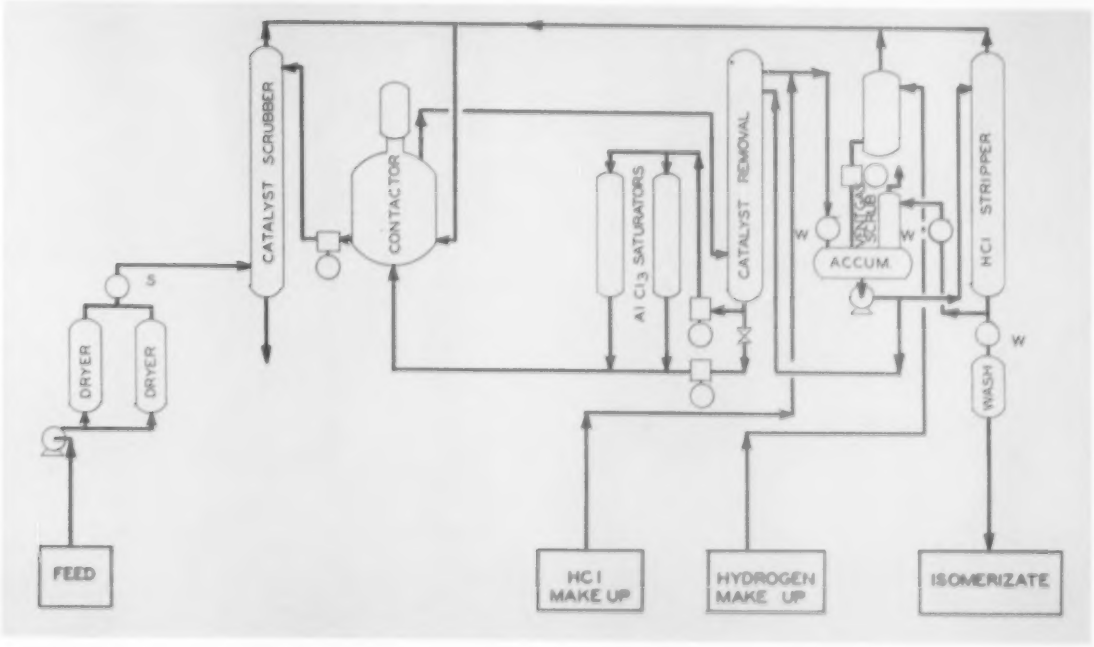
From the contactor the converted hydrocarbon stream flows to the catalyst column for separation and recycle of the dissolved catalyst components.

The small amount of noncondensate gas formed in the process is vented from the vapor space of the accumulator through a packed absorber. The HCl content of the vent gas is reduced to a minimum by a countercurrent wash with a cooled sidestream taken from the bottom product of the HCl stripper.

In pentane isomerization, most of the hydrogen is recycled from the vapor space in the accumulator; however, some remains in solution and passes to the HCl stripper from which it is recycled with the HCl.

From the catalyst column accumulator the isomerizate is pumped to the HCl stripper. The acid gas is removed from the top of the stripper and recycled to the contactor. The bottoms product stream is cooled and washed with dilute caustic to remove final traces of hydrogen chloride and antimony trichloride, and the neutralized isomerizate then passes to storage or subsequent operations.

Licensor for this process is Shell Development Co.



Normal Butane Catalytic Isomerization

"As more and more alkylate is used in producing high-octane motor fuel, there will be a greater and greater demand for isobutane. Some of this will have to come from butane isomerization."

THIS is a vapor-phase catalytic process for producing high-purity isobutane from normal butane. The catalyst utilized is aluminum chloride promoted with HCl.

A dry normal butane feed stock is vaporized, superheated, and fed, along with recycle HCl vapors, to a pretreater. The pretreated feed passes to the reactor. Both pretreater and reactor are bed-type chambers containing aluminum chloride sublimed on bauxite. The HCl vapors serve as a catalyst promoter. The reactor effluent of isobutane, normal butane and trace side reaction products pass through a bauxite filled guard chamber and are condensed in a series of effluent exchangers.

Noncondensables Removed

Trace noncondensables are removed from the liquid effluent stream in a vent-gas absorber and HCl is removed by stripping. HCl vapor overhead from the stripper is recycled to the feed pretreater. The stripper bottom product is caustic-washed and sand-filtered before being charged to the fractionation section consisting of a deisobutanizer and a deoiler tower. High-purity isobutane is yielded as an overhead product from the deisobutanizer. Normal butane is yielded overhead from the deoiler and recycled to the unit driers. A small quantity of pentane plus production is yielded as a bottom product of the deoiler.

Catalyst is added to the system by subliming the aluminum chloride with hot feed and depositing it on the bauxite in the pretreater and reactor. Makeup HCl is injected into the system downstream of the effluent exchangers.

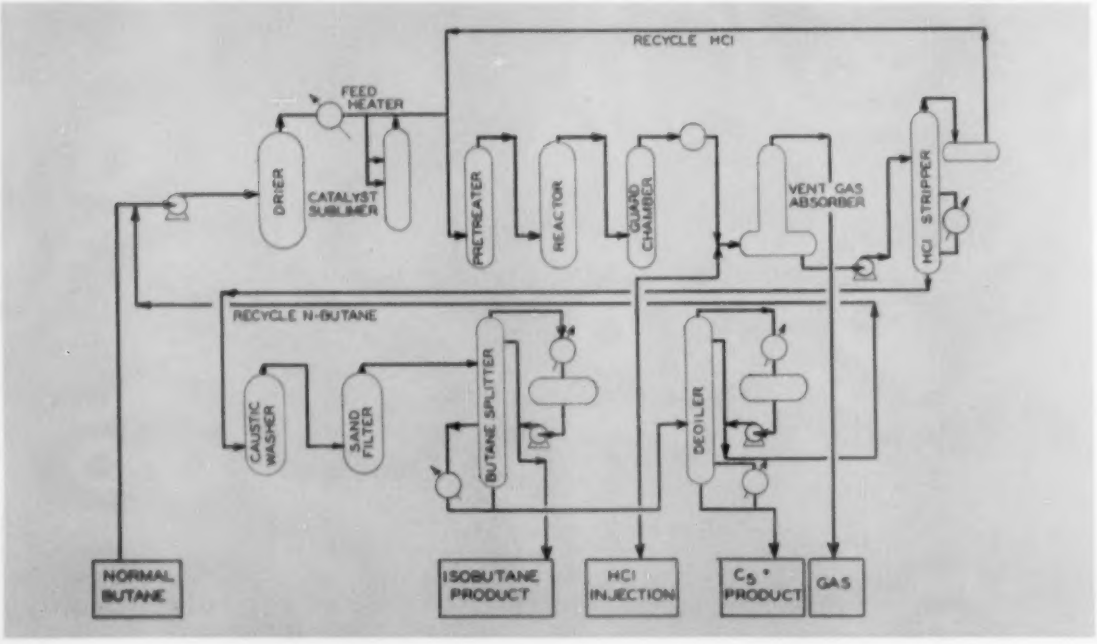
Information about the butane isomerization process may be obtained from the Perco Division, Phillips Petroleum Co.

TYPICAL CHARGE AND YIELD

Basis—100 bbl. of charge—50 per cent conversion per pass

	Charge (bbl.)	Isobutane yield (bbl.)	Deoiler bottoms (bbl.)	Vent gas (s.c.f.)
Ethane and lighter				Trace
Propane		5		
Isobutane	2	85		
Normal butane	96	2		
Pentane plus	2		8	
	100	92	8	

	Unit/bbl. isobutane produced
Utilities:	
Water circulation, 1,000 gal.	1.5
Water makeup, 1,000 gal.	0.045
Power, kw.-hr.	1.54
Steam, 1,000 lb.	0.680
	Lb./1,000 bbl. iC_4 produced
Chemicals:	
Aluminum chloride	85
HCl	70
Bauxite	440
Driocel for driers	7
Caustic	89



PENTAFINING

"Good octane improvement is obtained with minor losses to butane and lighter. Pentafining, along with low-pressure Catforming of C_6 and heavier, will upgrade 12-lb. R.v.p. natural gasoline to 100 octane at 3 cc. TEL."

PENTAFINING, a development of Atlantic Refining Co., is a new process for isomerizing normal pentane to isopentane. Good octane improvement is obtained with minor losses to butane and lighter. Pentafining, along with low-pressure Catforming of C_6 and heavier, will upgrade 12-lb. R.v.p. natural gasoline to 100 octane at 3 cc. TEL.

At existing octane levels this process combination should be very attractive to the natural-gasoline operator; and as octane levels increase, Pentafining may also be applied economically to the normal pentane fraction of straightrun naphtha.

Process flow . . . The flow diagram for Pentafining is shown in combination with fractionation and Catforming to produce isopentane of 95 per cent purity and Catformate of 96 octane from 12-lb. R.v.p. natural gasoline. The mixture of these two products blends at 100 research octane and 12-13 lb. R.v.p.

Pentafining catalyst is a combination of platinum and silica-alumina specifically designed to promote isomerization with low losses to fuel gas. Use of silica-alumina gives the catalyst complete tolerance for water and nitrogen compounds and requires no halide promoters, which contribute to unit corrosion. The catalyst is readily regenerable with a simple air-in-steam mixture.

Process performance . . . Fig. 1 shows the excellent approach to equilibrium attained by Pentafining catalyst at pressures of 300-700 psi. and temperatures of 800°-900° F. Fig. 2 shows yield-octane for the natural-gasoline processing outlined in the flow diagram. Catforming or isomerization alone will raise natural gasoline octane to the 95-96 level, while the combination of the two processes will give 100 3 cc. octane at 93.5 per cent yield.

Investment and Operating Costs

The low hydrogen recycle and catalyst requirements, and the basic simplicity of the Pentafiner, result in an investment of 100-200 dollars per barrel of charge, depending on size. Operating costs will be in the order of 10-15 cents per barrel. Fractionation requirements will vary for the individual refiner.

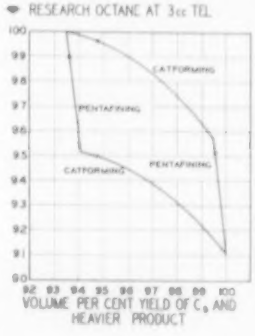


Fig. 1.

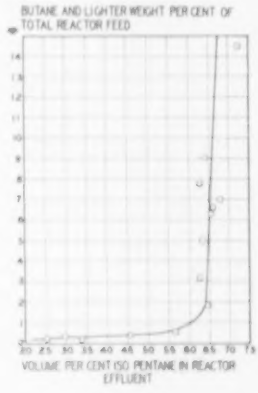
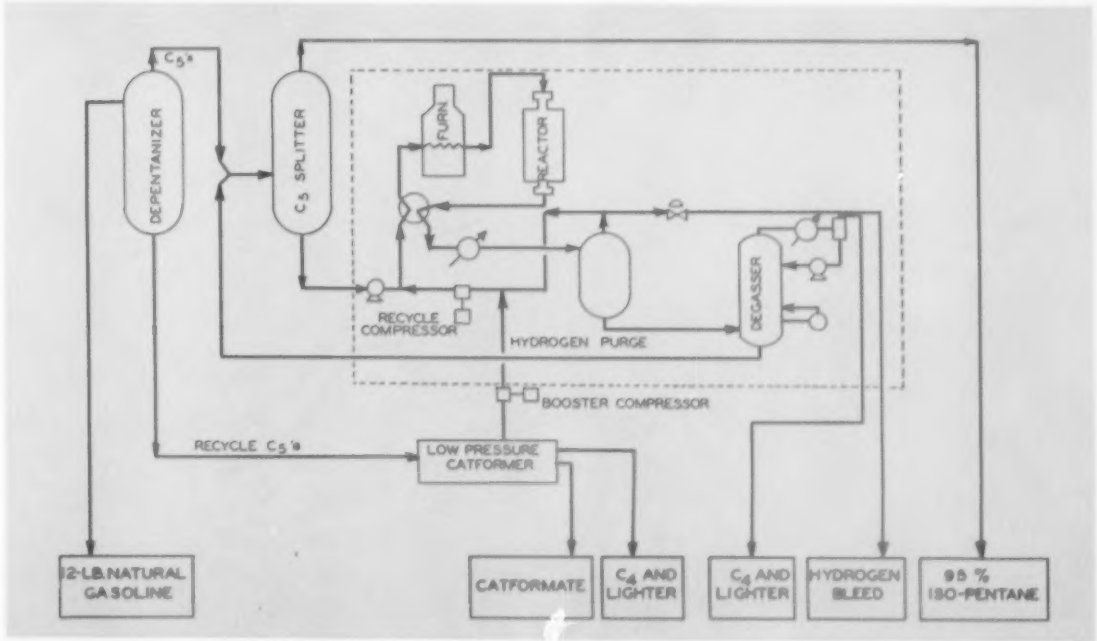


Fig. 2.



ISOMATE

THE Isomate process of Standard Oil Co. (Ind.) converts low-octane number hexanes or hexane-pentane mixtures to higher-octane-number isomers with low loss in yield. The process was first used commercially during World War II in two plants operating to produce aviation-gasoline blending stocks. With the trend toward higher and higher octane motor fuels the Isomate process is again of interest to refiners.

The Isomate process complements catalytic reforming by upgrading light naphtha fractions which cannot be reformed satisfactorily. The high volatility, high-octane-number Isomate product is an excellent blending stock with heavier catalytic reformates. Process and engineering improvements have been made to adapt the process to present-day high-octane-motor-fuel requirements.

Operating conditions . . . The Isomate process employs reaction temperatures of about 240°-250° F. Hydrogen is added to obtain a total pressure of about 700-800 psi.

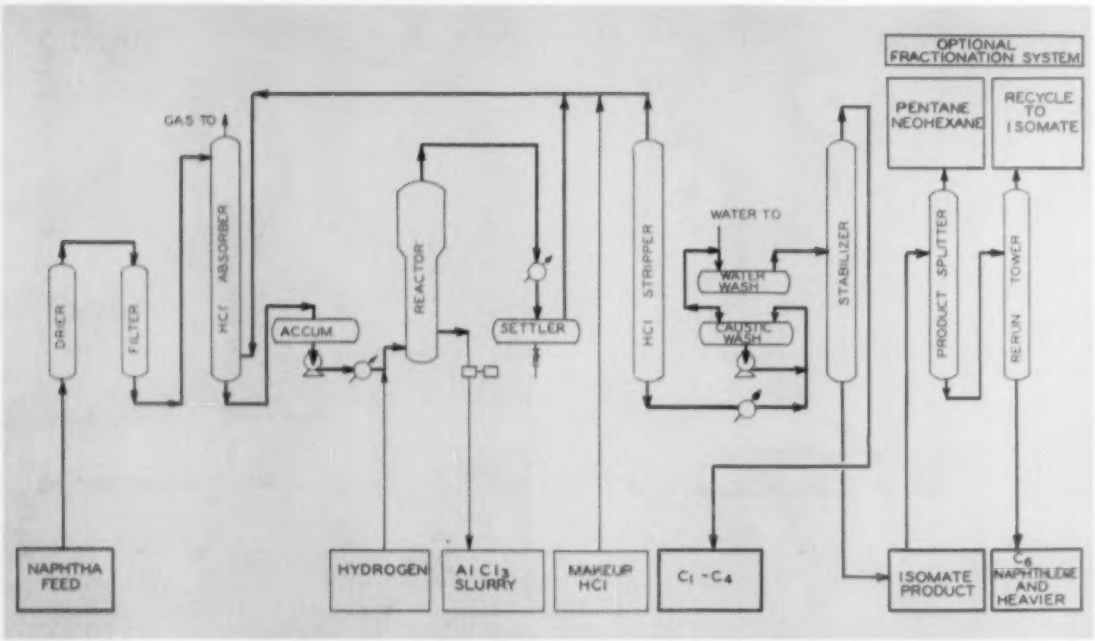
Feed stocks . . . The process is especially suited to the upgrading of hexanes. Pentanes may be included in the feed.

Process description . . . A flow diagram of the Isomate process is shown in the figure. The process may be designed for once-through operation (shown to the left of the vertical broken line) or product fractionation with recycle may be added if even higher-octane-number products are required. The catalyst is an aluminum chloride-hydrocarbon complex promoted with anhydrous hydrogen chloride. By employing hydrogen pressure, cracking and disproportionation are suppressed and catalyst activity is maintained.

Data . . . Typical feed stock and product inspections as well as yield data are shown in the table. Three different operations are illustrated: Once-through mixed pentane-hexane isomerization; once-through hexane isomerization; and recycle hexane isomerization.

TABLE 1—TYPICAL FEED STOCKS AND PRODUCT-INSPECTION DATA

	Mixed pentane-hexane isomerization		Hexane isomerization		
		Once-through		Once-through	Recycle
A.S.T.M. distillation:	Feed	product	Feed	product	product
I.b.p.	112	102	142	115	100
10 per cent	123	115	148	130	112
50 per cent	133	128	150	149	122
90 per cent	149	154	155	180	127
Maximum	164	245	171	300	132
Gravity, °A.P.I.	80.8	82.0	75.7	77.4	86.5
Octane number, C.F.R.-R.:					
Clear	69	83	63.5	79.4	89.9
+ 3 cc.	89	98	84.8	93.6	Isooctane + 1.05 cc.
Yields, volume per cent:					
C_4		4.5		4.2	7
C_5-C_6		95.5		95.8	82
Naphthenic bottoms					11



MODERN REFINERY EQUIPMENT

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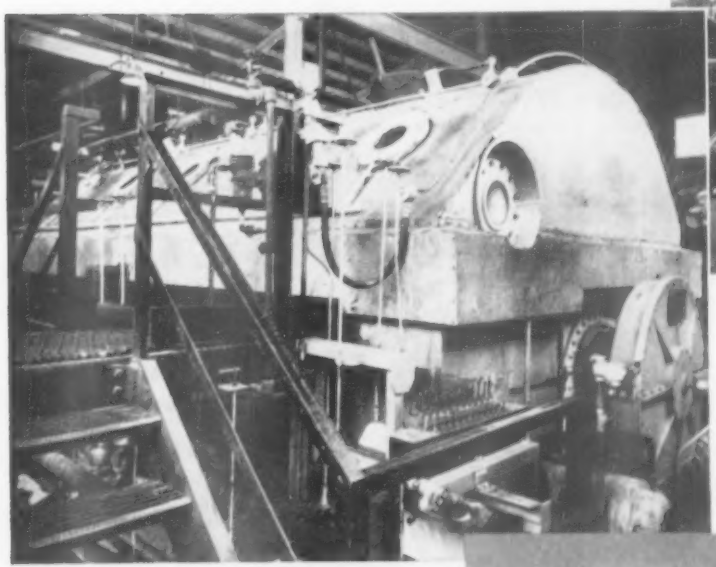
FLUID CAT CRACKER

CB&I built the reactor-regenerator and catalyst hoppers for the UOP fluid catalyst cracking unit shown above at the Rock Island Refinery Corp., Zionsville, Indiana, refinery.



CONKEY SOLVENT DEWAXING FILTERS

These filters are specifically designed for the clarification filtration of oil solvent mixes for the recovery of slack wax in refinery MEK solvent dewaxing plants. They are also applicable to product wax recovery from recrystallization filtration of slack wax with concurrent removal of product wax and soft waxes from low cold test oils.

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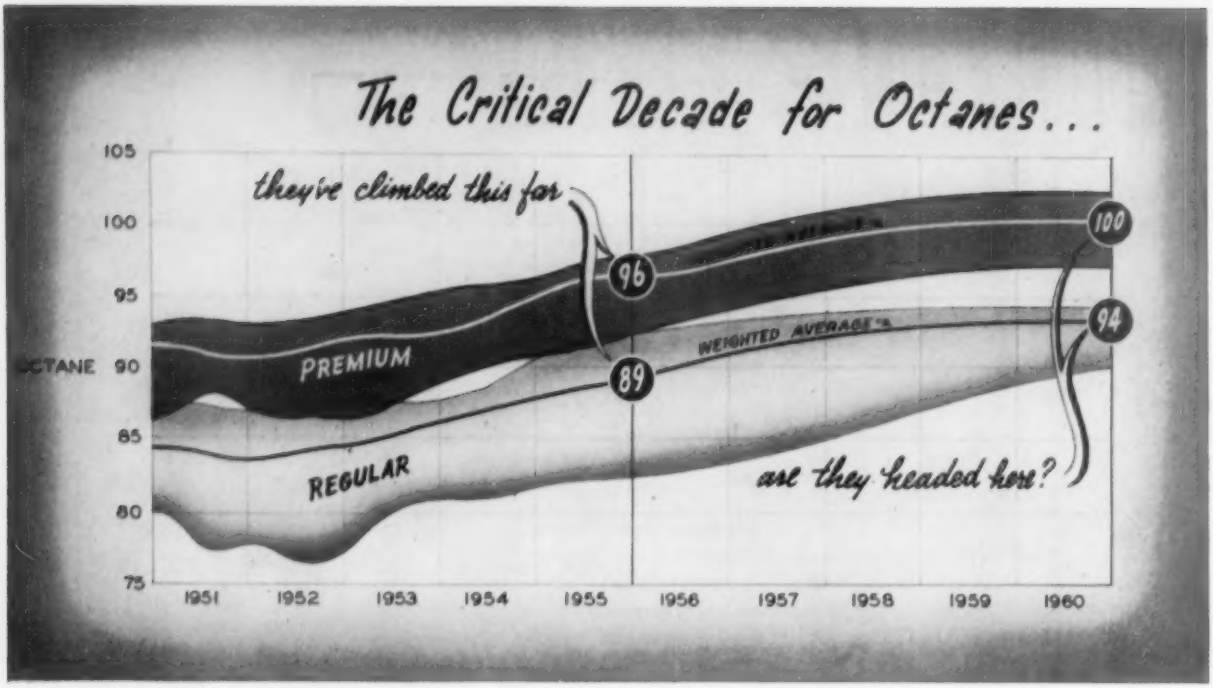


How High Are Octanes Going? . . .

While there are many schools of thought as to just what the gasoline picture may resemble 5 years hence, the chart above is a fair consensus

by George Weber
Refining Editor

HOW high are octanes going? And what will refiners do to make them? These two questions are of prime importance today. They will remain unanswered except by degree, for several years to come.

For the present, refiners are occupied with meeting the expected 100-octane level on premium gasoline. This is enough of a problem for now. But before that level is reached, the industry will need to lay the groundwork for making even higher antiknock-quality fuels.

There are no firm signs of any alternatives to this challenge for the next few years. The gas-turbine engine seems certain to enter the picture some day. But no one knows when it will become an effective factor on fuel consumption. And no one can foresee the degree to which it will ultimately supplant the piston engine of the future.

100-octane coming . . . The long-heralded day of 100-octane premium gasoline is close at hand. The reasoning is quite valid that octanes today are higher than they need to be. No more than a handful of the cars now on our highways get full realization of the power in 97-octane premium gasoline marketed in many cities.

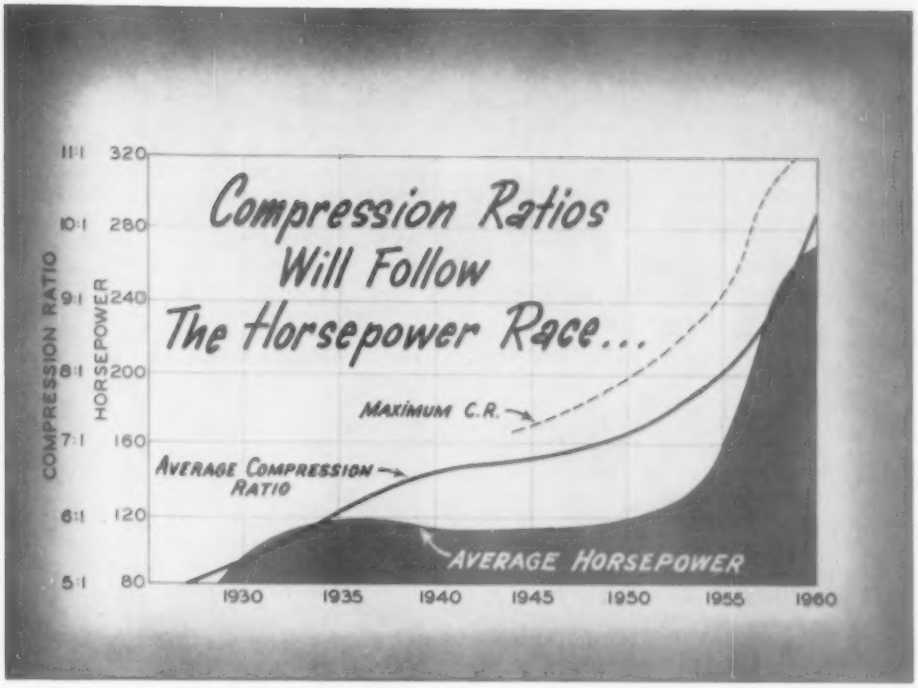
The same reasoning will doubtless hold when 100-octane premium hits the industry. But it will not forestall that day. Brisk competition within the oil industry plus continued pressure from new high-requirement cars will probably serve to keep octanes higher than necessary for the great bulk of motorists indefinitely.

Maybe in '57 . . . It is probable that not even the first company to market 100-octane motor fuel commercially knows when the move will come. But the consensus in the industry indicates that 1957 may well be the year, and some think it might happen before then.

Once this salesman's goal line is crossed, however, it is expected to be followed by a competitive spurt in average octane ratings. Further conjecture on this coming event is fruitless.

The probable trend . . . The octane chart across the top of this page is presented only as a probable estimate of the picture to 1960. What are the factors that have led to octane increases in the past 2 years? What factors will militate for higher octanes in the future?

The industry must concede that the octane race, at least during the recent past, was incited primarily by internal competition. This was a natural outcome of the excess in crude-processing capacity plus the record building of new process units contributing to motor-fuel quality. The effect of new car models introduced during the past few years has been one of steady pressure for higher octanes. But Detroit has kept fairly well within the limits of available antiknock quality in new-model requirements, merely taking up the slack



"The long-heralded day of 100-octane premium gasoline is close at hand. The reasoning is quite valid that octanes today are higher than they need to be . . . but brisk competition within the industry will probably serve to keep octanes higher than necessary for the great bulk of motorists."

. . . And How Will They Get There?

which developed between the periods of new-model introduction.

The same interplay of factors may reasonably be expected during the next few years. Basic refining capacity is again on the increase and an operating cushion over expected demand will probably remain at least for a time. The installation of additional catalytic cracking and reforming capacity is continuing unabated, hence the ability to produce higher-octane fuels will keep pace with the incentive to do so. Detroit may be expected to adapt future car-engine design as closely as possible to the rising octane trend and that pressure must be expected to continue.

Five years hence . . . While there are many schools of thought as to just what the gasoline picture may resemble 5 years hence, the accompanying chart shows a fair consensus. The spread in octane ratings for both premium and regular represents the difference between the highest and lowest average octane ratings noted in major cities and marketing areas. If the extremes of individual brands were plotted, the bands would be even broader.

It is noted that weighted average octane rating has consistently remained near the top of the range since, with some exceptions, the areas with low octane ratings are also those with relatively low gallonage.

At many times in the recent past, the two grades have overlapped. In the East, where regular-grade octanes are high, some brands of that grade have had a higher rating than premium grade in low-octane regions, such as the high-altitude Mountain states. Some students of octane trends believe that this overlapping will occur less in the future, and that the octane spread between the two grades may become wider. It is fondly hoped, though futilely to date, that the price spread will also grow by virtue of firmer prices for premium-grade gasoline. On the basis of quality alone this is certainly logical, but competitive marketing factors preclude any such prediction with certainty.

Also predicted is a gradual trend toward greater volume of premium-grade gasoline. This seems firmly in the books and some predict that 10 years hence, premium will take over most if not all of the gasoline market.

It could change . . . But factors not now evident can upset these predictions sharply. One such factor which came to light just last month might possibly change the entire concept of premium and regular grades of gasoline. That development is the market test now under way in Orlando, Fla., by Sun Oil Co.

Using special blending pumps at service stations in this restricted test area, the company is marketing not its traditional single grade, nor the usual two grades, but five grades ranging in octane rating from regular to super premium in the 100-plus octane range.

It is still far too early to evaluate this possible effect on marketing practices. But while the same idea has occurred to other refiners, this is the first full-fledged marketing experiment to be launched. Assuming that the company gets the favorable response that it probably privately expects, Sun will adopt this practice throughout the East Coast and into the Great Lakes region.

The impact of such a move is hard to assess, but it could conceivably meet with like competitive measures. In this event, the whole concept of two grades would go out the window and the next 5 or more years might see a gradually rising band of multiple overlapping octane grades.

With tailor-made octane blending at the pump, it is probable that top octanes would be higher. Although an experiment cannot be counted for commercial practice, we already have in

"Big question is whether the motorist will accept tailor-made gasoline . . ."

effect a 100-plus octane superpremium grade now being marketed in Orlando.

Pricewise, this new practice could possibly benefit the industry. In the test case, yet to be proved, recommended prices for the five various grades show a total spread of 5 cents per gallon between regular grade and superpremium.

The spread between grades corresponding to regular and premium in that area might be on the order of 2½ to 3 cents. If the refining economists' arguments are valid, this graduated octane and price scale should more nearly represent the true value of gasoline than does the traditional dual-grade system. The big question is whether the motorist will accept tailor-made gasoline to fit his needs, in the face of competitive measures which will undoubtedly develop.

Pressure from Detroit . . . Detroit is watching these developments with high interest. Those close to that industry expect the intense competition for new car sales to continue many present trends. As projected in the chart on future engine characteristics, Detroit seems bent on a horsepower race which may dazzle the prospective car buyer with 300-hp. models within the next 2 or 3 years. The 1956 models made a significant upward move in power across the board. This matched the spectacular moves for top position in prestige horsepower among the luxury cars.

Detroit can't build bigger engines. A look under the hood of a new car shows why. So, designers must resort to upping compression ratio and "souping" up carburetion to gain the added power the salesmen demand.

The compression ratio curve shows what refiners might reasonably expect by 1960. With one 10:1 ratio car now in production, it is reasonable to expect models of 11:1 or higher before 1960. The average may climb even more sharply than shown, as lower models close the gap.

Predicting the future of octanes is a hazardous occupation today. Crystal balling in this area has been consistently conservative during the past few years. Many an octane chart has been moved up 2 years by startled students of postwar trends. It may be that the charts which here show what might be a consensus at present will prove to be too conservative. Suffice it to say that the pinch is on and refiners are hard put to squeeze out every octane possible in the future picture.

Where are octanes coming from? . . . Where do we go from here? By many routes, apparently. None of them, however, offers the broad avenues to higher octanes that catalytic cracking and reforming brought about. Both of these process types will be extended, but the average refiner now sees no new process which will permit him economically to add octanes in large numbers to his gasoline pool.

Further octanes will come in small nibbles. And they will all cost money.

One of the most promising means to higher octanes lies in isomerizing straight-chain hydrocarbons in the pentane and hexane range. This has the dual advantage of converting a low-octane component of motor fuel to a much higher one.

Isomerization looks good . . . New isomerization processes now appearing are a sign of the times. It is strongly indicated that this technique will be adopted within the next few years by many refiners. In the process section of this special number are three methods for isomerizing pentanes and hexanes. Two of them—Shell's liquid-phase isomerization and Indiana Standard's Isomate—were developed during the war and are now being improved to meet the new need. The third, Atlantic's Pentafining, is a new development aimed specifically at upgrading normal pentane. More are coming; two other versions will probably be introduced later this year.

The isomates have many favorable characteristics. They can be synthesized from feed stocks which do not reform well. Yields are high. The paraffins are clean-burning in contrast to reformate and catalytically cracked fractions. Octane appreciation is impressive for some particular isomers, and for mixed product from recycling octane betterment of 20 or more research numbers is possible.

Moreover, isomate blending values appreciate when blending with higher-octane base stocks, in contrast with polymer gasoline for example. From all appearances, isomerization of light naphthas represents the greatest room for improvement of existing gasoline stocks.

More alkylate coming . . . Alkylate is fast becoming an important component of motor fuel. The bulk of today's alkylate still goes into aviation gasoline where realization is higher. But regardless of its high cost, this clean-burning, high-octane blend is finding its way more and more into premium-grade gasoline. It is not possible to determine just what fraction of today's premium grade is alkylate since many refiners blend it as it is available over and above avgas requirements.

The construction of added alkylation facilities in the face of a static future market for avgas is a strong indication of the coming importance of this blend stock in future motor fuel. Last year, alkylation capacity in this country rose about 12 per cent and a further addition is slated to boost capacity nearly 10 per cent during 1956. The aggregate capacity on a stream-day basis is expected to approach 300,000 bbl. sometime next year, as reflected by announced building projects at this time.

The rising proportion of alkylate in motor fuel will partially offset the trend toward higher sensitivities which followed the wholesale adoption of catalytic reforming. Should the octanes continue upward as indicated, alkylation shows promise of becoming a standard process in the future refinery. Still a high-cost item, alkylate shows promise of becoming a more practical component of motor fuel. Much work is under way to shave capital and operating costs. Better acid recovery and removal of troublesome acid and neutral esters from reactor effluent promise to contribute much to the economics of alkylation in the future.

Expanded reforming . . . The industry is steadily improving its ability to make higher octanes, with a continued building program for catalytic reformers. This year alone, more than 350,000 bbl. per stream day in new capacity will be added, raising the national level from about 11 per cent of crude capacity at the first of this year to over 14.5 per cent by year's end.

The reforming technique is being greatly expanded by use of hydrogen treating of feed stocks. With this pretreating, sour stocks and thermal naphthas can be successfully reformed.

No one knows how much catalytic reforming will eventually be installed in American refineries. But we have not yet approached saturation. Some refiners are operating or building facilities amounting to 30 per cent of crude capacity. This lends support to the conclusion of a recent study which forecast a total catalytic reforming capacity of 2,500,000 bbl. per day within the next 10 years.

Many companies are now on their second round of cat reformer construction. It appears that probably double the present total capacity will ultimately be built.

Latitude on reforming severity . . . Once saturated with catalytic reform-

"Natural gasoline as a blending stock has largely been left behind . . ."

ing capacity on the basis of available feed stocks, the refiner has further octane latitude in the degree of severity with which he reforms. In general, higher conversion levels of reforming produce a lighter reformate and a lower yield. To some extent, the increased production of light ends can be utilized for alkylation and polymerization. Each specific case must be judged on its own merits when the refiner is considering the advantages and disadvantages of reforming severity.

The extension of reforming to include extractive separation of reformate into high and low-octane fractions adds another dimension to this valuable tool for making octanes. Three alternates are available. The refiner can make octanes by subtraction; diverting the low-octane fraction to jet fuel. Or, he can process the extract in a thermal reforming unit. Refiners who already have such facilities available in their plants may adopt this practice first. The third scheme, and possibly the one which will find largest acceptance eventually, is the recycling of the low-octane fraction to the catalytic reformer. The economics and results of these alternatives are discussed in the pertinent process descriptions on Rexforming and Iso-Plus appearing in the process section of this issue.

Cat cracking a growing factor . . . Catalytic cracking is also on the upgrade. Capacity for total feed to catalytic reactors is being expended on the basis of crude capacity. In many cases this operation is expanding due to increased recycling of catalytically cracked product. In this operation the extraction and hydrogen treating of cat recycle stocks is improving the economic picture.

As refiners whittle away at the bottom of the barrel, they provide added charge stocks admissible to catalytic cracking units. Deeper vacuum cuts, propane and propane-butane extraction, and thermal coking of bottoms fractions all contribute added feed stocks to cat crackers.

At the first of the year, catalytic cracking capacity representing total charge to reactors stood at about 39 per cent of basic crude capacity. Additional construction scheduled for this year will boost this to about 41 per cent taking into consideration the added crude capacity to be installed by 1957. Before the end of 1956, catalytic cracking in the United States will pass the 3,000,000-bbl. per stream day mark.

Cat cracking resids . . . The catalytic cracking of topped crudes has come more into the picture during the past year. Sun Oil Co. is now charging residual stocks to a Houdriflow unit converted to what is called Houdresid operation. Two other Sun Houdriflow units at Marcus Hook, Pa., and Toledo, are designed for future conversion to Houdresid operation. A recent study shows that gasoline produced in the Houdresid operation is similar in octane and other characteristics to gasoline produced in the conventional Houdriflow process.

Other refiners have been charging residua to catalytic cracking units with success. In cases where a long fraction of this heavy stock is converted, it comes from crudes which have low content of metal contaminants. In several cases, refineries are blending residual cuts or whole crude with conventional cat cracker feed stocks in both fluid and moving-bed units.

The hydrodesulfurization of whole crude or crude residua is now a technical possibility, although no commercial application has yet been made. When economics favor this approach, as eventually expected, a larger fraction of the crude barrel will go to catalytic cracking.

What about natural? . . . Natural gasoline as a blending stock for gasoline octane has largely been left behind in the recent rise in antiknock quality. But some of its components would make excellent blending stocks, while others could be upgraded to find a place in motor fuel now and in the future.

The isopentane fraction which averages about 20 per cent of most natural has a high research and motor antiknock rating. Normal pentane averaging 25 to 30 per cent can be isomerized—at a price. Hexanes represent likely feed stocks for isomerization, either alone or in conjunction with pentane, and the hexane and heavier fraction which runs roughly 50 per cent of natural gasoline is being catalytically reformed in some cases.

These potentialities of natural gasoline as a feed for processing too high octane motor fuel components are well known. But economics today bars their wider use. Most field processing plants are too small to justify the costly facilities needed for superfractionation and processing, and the pooling of plant production is hampered in most cases by distance.

Some of these light fractions are being blended with crude for pipeline delivery to refineries, where they can be processed in existing units. In other cases, particularly those where cycle product or condensate is available, the heavier fractions are being catalytically reformed.

A better future? . . . It is reasonable to assume that the future pressure for higher octanes will bring more of these valuable stocks into the gasoline picture. If refiners continue the trend toward improved light-ends recovery and separation, and follow the isomerization route as indicated, they should be able to use more of these field processing liquids.

Butane is currently in long supply in many sections of the Southwest. Consumption in L.P.G. has dropped considerably. Fleet operations using straight butane are catching on for bus and truck operation, but still take only a small fraction of the supply. The rise in alkylation may bring isobutane more strongly into the refining picture. Recent volatility surveys made by Ethyl Corp. show that gasoline volatility throughout the country remains well below the allowable. Last August, the arithmetical average of premium-grade R.v.p. in 53 cities was 8.4 lb. House brand averaged 8.4 lb. In November the averages were 8.7 lb. for premium and 8.9 for regular.

Natural-gasoline manufacturers regularly refer to this situation in promoting further sales of butane for volatility blending. Some relief is coming from the car makers. If future cars prove more resistant to vapor lock and if the economic incentive to use more butane improves, refiners could realize some further octane advantage from use of more of this high-antiknock component.

Polymer gasoline . . . At the higher octane levels of basic blending stocks, polymer gasoline has lost some of its blending advantage. The current refinery survey shows that capacity for this type of process is growing only slightly. Percentagewise polymerization capacity now stands at slightly over the 1.6 per cent level reported last year.

Blending tricks . . . With a given volume of catalytic and reformed gasoline in his gasoline pool, the refiner can make money and octanes by careful attention to splitting and blending these components to the two grades of gasoline. This procedure can also raise the ceiling on premium octane, if desired.

It is difficult to generalize on this technique since each refiner's position differs from others. Some examples show what can be done. By splitting both cracked and reformed gasoline

"A useful tool coming into use in gasoline blending is the digital computer."

components, the refiner can realize a high-octane premium by blending the light cracked fraction with the heavy reformate fraction.

Splitting pentanes and lighter from cat cracked gasoline gives a light fraction which can run 99 leaded research octane number. This will blend with a heavy reformate to yield a leaded fuel on the order of 115 research octane number. In other cases the light cracked stock can be split to include all of the C_7 components which will blend to better than 100 octane with a good reformate. In order to realize this, the cracked and reformed streams must show a pool rating of 88 to 92 clear.

Some refiners are realizing higher octanes by removing the heaviest 5 to 10 per cent of catalytic cracked gasoline and removing that small fraction from the gasoline pool. In some cases this heavy fraction can be degraded to jet fuel or middle-distillate products. Other refiners split cat cracked gasoline on a rough 50-50 basis, blending the light fraction to premium and the heavy one to house-brand gasoline.

If a refiner has a market for good-quality diesel fuel, there is no reason for including light ends in the cat cracker charge stocks. With proper attention to feed stock, the whole cat cracked gasoline fraction can in many cases run 94 to 94.5 clear and 98 to 99 leaded.

Several refiners are today producing 100-octane reformates in conventional fixed-bed platinum processes, without resorting to extraction and recycle. Higher reforming severity produces more light reformate. The light fraction is not upgraded as much as the heavier component.

For example, a 25 per cent front-end fraction of a 91-octane clear whole reformate would rate about 75 clear and 92 leaded. At higher severity, producing 100-octane clear reformate, the light fraction of comparable octane rating would amount to about 50 per cent of total reformate. In this case, the heavy fraction would lead up to about 100.

A few rule-of-thumb findings from reforming operations might apply to many refiners' cases. Splitting the whole reformate at the 300° F. point usually results in a light fraction with a leaded octane rating equal to or a little higher than the clear rating of the whole. Cutting a 95-octane clear pool octane reformate at this point will yield a light fraction which will run about 97 with 3 ml. TEL, plus a heavy fraction which will lead up to isooctane plus 1 ml. TEL. The heavier fraction includes such high octane components as toluene, xylenes, and ethyl benzene while the light fraction comprises largely benzene. Where to cut and how to blend the split fractions can best be determined by trial and error in each individual case, to produce the best balance of hydrocarbon and TEL octanes in both gasoline grades.

Blending tricks to raise premium octane ceilings impose a problem in maintaining regular-grade quality. If the spread widens between octane quality of the two grades, the refiner may continue to gain some advantage from splitting and blending his base stocks. But the problem of disposing of low-grade gasoline fractions will grow rapidly if the ratio of premium to regular demand continues. Jet fuel may provide some outlet for these fractions, but to what degree is questionable.

Electronic computers . . . A useful tool which is coming into play in gasoline blending is the digital computer. While blending values are not generally linear, it is possible to break up a blending curve into segments which may then be considered as straight lines. Given a fixed proportion of the several blend stocks in a gasoline pool it is possible to feed the many correlations into the computer and derive rapid results on various blending schemes. In the future, with sufficient know-how on such operations, it is considered possible to optimize blending operations, or at least approach the best optimum scheme for blending multiple gasoline streams to regular and premium grade.

Refinery simulations . . . Electronic computers have a much greater potential use in refining than blending of gasoline stocks. Presently they are being used to simulate complete refineries and ultimately should prove possible to employ the countless factors involved in several processes and optimize the whole operation for greatest profit.

In the beginning, single units such as catalytic crackers are tackled. The factors represented by type of feed stock, operating conditions, recycling, etc., can be fed into a computer which can then simulate the unit by giving yield and quality results on products to be derived from any set of conditions. The results to be expected from varying certain factors can be obtained and evaluated quickly.

Optimization is coming . . . With this background it is practical to optimize the operation of the single unit. Having followed this course with other units, it is then possible to simulate their operation in combination. Given sufficient computer capacity the ultimate goal of arriving at optimum returns for a complete refinery is now believed possible. This procedure applies not only to determining the operating conditions at which each unit should be run for best over-all results. It goes further in showing what crudes will show the greatest practical profit.

The application of electronic computer studies to refining operations is being pushed by a number of companies. In order to keep abreast of this important development smaller refiners may pool their resources and efforts in joint computer programs.

The electronic computer stands alone in its ability to relieve hard-pressed refinery planning groups of the endless calculations necessary to arrive at their conclusions. With charge stocks, yield requirements, and quality and price of products varying daily, the task of determining the best scheme becomes one of educated guessing at best, by manual means. Any fast answer giving a refining scheme even approaching optimum becomes impossible, since the application of daily changing factors to the countless operating factors becomes burdensomely complex. The computer can better solve this dilemma by giving answers quickly enough to be useful, and ultimately by arriving at results which cannot humanly be reached with any number of personnel in planning groups.

The long look . . . While preoccupied with the immediate problems of boosting octanes and staying in business during the next 10 years, refiners are also watching three long-range trends. The most popular subject for speculation is the gas turbine.

Many hurdles remain before the gas turbine can compete in the automotive field. They involve so many unanswered questions that any prediction of the arrival of the "gas turbine age" must of necessity be an educated guess at this point.

A consensus now appears to be that the first commercial gas-turbine vehicles will appear on U. S. highways within the next 5 years. If this does happen it will still mean little to refiners. The first vehicles to appear may be trucks or passenger sport cars. These are already undergoing tests by makers, but on an experimental basis only.

After the formal introduction of commercial gas turbine cars for the U. S. motorist, a period will follow during

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"Before the advent of the gas turbine, an interim possibility is fuel injection."

which customer reaction will add another unknown factor to the many mechanical ones remaining. Even if technical progress plus customer approval proves very favorable, it is believed that a major impact on the motor-fuel picture will not be felt before 1970.

Some new "ifs" . . . It is interesting to note that some of the more vocal prophets of the gas turbine age have recently added qualifications to their predictions. One now hears the phrase "if and when the gas turbine takes over the automotive field"—that "if" being a new addition in some cases. Some believe that the gas turbine may take its place in the automotive field without sweeping it altogether.

Aside from the many problems to be solved in the technical field, two assumptions must be borne in mind in looking at the gas turbine. In the first place, it is not valid to compare present or anticipated fuel efficiency of the gas turbine with the present efficiency of the piston engine. It is conceded that much improvement remains to be squeezed out of the piston engine with higher compression ratios, fuel injection, better design of combustion chambers, and attention to what are termed "milder" engines. Hence the gas turbine will have to compete with a better piston engine in its future bid for the field.

Secondly, one cannot expect the gas turbine to operate on a "cheap" fuel. In its early application, it will have to burn house-brand gasoline. During the initial stages of its adoption it may actually be welcomed by refiners, by providing a "sink" into which can be relegated the low-octane gasoline stocks which by that time will no longer be permissible in regular-grade gasoline. In fact, there may be no market for regular grade by that time. The gas turbine added to the jet aircraft may be welcomed in providing an outlet for all but the highest-octane stocks which are going into the superpremium of the day.

It is conceivable that this state of affairs may improve the position of both the gas turbine and the piston engine. The latter with the highest compression ratio mechanically possible may remain in the field for some further time to come, receiving the cream of existing processing units which must be amortized. The two may exist side by side for an indefinite period, with ultimate survival dependent on the performance expressed in miles per barrel of crude, or miles per dollar.

By this future date, it is further conceivable that the American motorist's current preoccupation with wheel spinning at green lights and power-consuming gadgetry may well be cooled a bit by much higher fuel costs across the board. According to some observers we are approaching the end of an era of plentiful liquid fuels. Conservation and cost may play more important roles when the showdown comes on the gas turbine vs. the piston engine.

Fuel injection . . . Before the advent of the gas turbine, an interim possibility is fuel injection. The principle involves the direct metering of gasoline to each cylinder of a piston engine.

On the plus side, fuel injection will result in greater power, better economy, and lower octane requirements as compared with conventional carburetion. Contributing advantages include lower engine wear, fuel cutoff during deceleration, better distribution to cylinders, less oil dilution, and elimination of carburetor icing.

Refiners and natural-gasoline manufacturers are interested in the fact that fuel injection will permit use of higher-vapor-pressure fuels and higher-end-point fuels.

Cost seems to be the primary objection. But compared with dual carburetion the higher cost is not considered prohibitive and mass production should reduce the price a reasonable level. Many look for fuel injection to be introduced in 1957 probably in a sport or luxury model. But if any automotive companies are planning to adopt fuel injection in large-volume models, they have not yet announced such an intention.

No early effect on fuels . . . Still, it appears that fuel injection may well find wide application before the piston engine has realized its full potential. But any effect on widening the boiling range of gasoline must await full adoption by all makers and the scrapping of all carbureted cars. This relegates fuel injection to a questionable period so far as refiners are directly concerned. Of course, the greater economy and octane appreciation of fuel injected engines will contribute to higher efficiency. But any advantages that accrue to engine octane appreciation will be promptly exploited with higher compression ratios. Any expectation that fuel injection will modify the pressure on fuel octanes is naive.

"I'll be glad to read it back, sir 'Olig and Glass Jurgle, Tulgsa, Oklahogga, Deerg Seff."

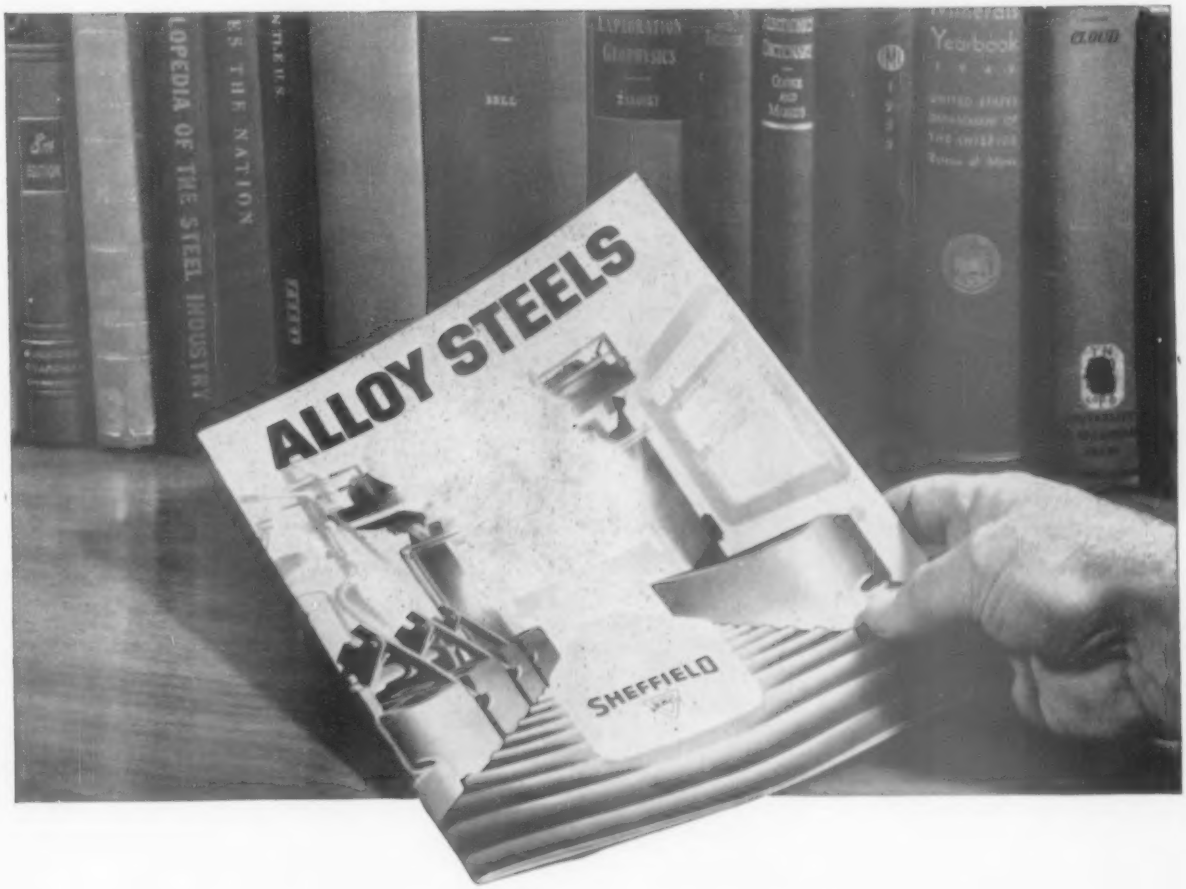
The third long-range trend which refiners are watching concerns other ways in which the piston engine can improve its appetite for high octane fuels of the future.

Combustion-chamber design represents one possibility. Some encouraging signs are seen. Next year will bring out pistons with concave tops designed to improve so-called mechanical octanes. The relationships between chamber design and knock appear to be so complex that no straightforward means of improving design is available.

Fuel sensitivity . . . A serious problem facing both industries concerns the rising sensitivity of premium-grade gasoline, and the tendency toward more severe engines. Both trends combine to penalize gasoline of high F-1 research ratings.

The spread between the F-1 and road ratings of gasoline is something which must be accepted both now and in the future. The industry is geared to make high octanes with processes which produce large volumes of sensitive blending stocks. Greater adoption of alkylation and isomerization may partially offset the effect of reformates, to modify the trend toward more sensitive fuels. But they will not be available in sufficient quantity to reverse it.

The onus of improving this deteriorating situation seems up to Detroit. Use of automatic transmissions has raised the speed of maximum octane requirement. This results in what is termed a severe engine which penalizes today's high-octane fuels. There is a strong need for research aimed at the design of milder engines which can better utilize the top octanes which the refining industry produces. This field has only begun to be explored. Competitive advantage to be gained with these milder engines should provide an incentive for more research in that direction.



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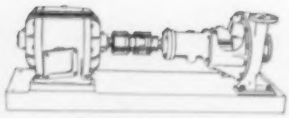
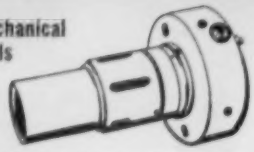
BJ pumps for the petroleum industry



BJ chemical pump with mechanical seal

Fitted with special BJ Mechanical Seal which provides positive protection against leakage to bearings or contamination of the pumped liquid. Adjusting sleeve permits easy impeller adjustment without dismantling.

mechanical seals



Replace standard packing in stuffingboxes. Eliminate excessive leakage and frequent repacking. Recommended for corrosive, high temperature or volatile liquid pumping. Prevent contamination of pumped liquid.

type VMT pumps

Designed for pumping liquids from sub-zero to 750° F.—corrosive or non-corrosive—where NPSH is limited. Capacities to 5000 GPM and heads to 575 ft. Smaller "VLT" models also available in capacities to 120 gpm.

vertical circulating pumps

Single or multi-stage. For pumping medium to high capacities of water. Two size ranges. Capacities to 50,000 gpm. Heads to 40 feet. Saves space, simplifies piping. For cooling tower, dewatering, drainage, river-intake and circulating.

hydropress pumps

For medium to high pressure pumping at low capacity. Vertical construction saves space, simplifies installation. No relief valves required. Uniform non-pulsating flow. Capacities to 300 gpm. Heads to 7000 ft.

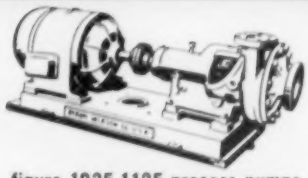
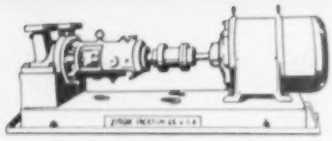


figure 1025-1125 process pumps

Moderately priced pumps for general-purpose handling. Available with BJ Mechanical Seal. Capacities to 2000 gpm, heads to 800 ft. Temperature limit 350° F.

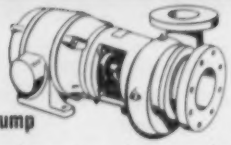


2-stage SM process pumps

For pumping fluids over a wide range of pressures and for temperatures up to 800° F. Ideal for pumping hot or cold liquids near their boiling point. Capacities to 2200 gpm and heads to 1600 ft.

multiplex pumps

Recommended for boiler feed, pipeline, debarking and all classes of medium-to-high pressure and temperature service. Easy inspection or cleaning without disturbing piping, bearings or driver.



bilton pump

A general-purpose, close-coupled pump and motor unit. Mounts in any position with no rigid base needed. Especially useful where space is limited. Available with BJ Mechanical Seal and explosion-proof motor. Capacities to 2000 gpm and heads to 475 ft.

submersible pumps

For well pumping, booster stations, or for standby service. Pump and sealed motor operate completely submerged. No pump house or surface structure needed. No well too deep. Ideal where flood menace exists. Capacities to 20,000 gpm and heads to 1800 ft.

sumpmaster pumps

Available in more than 3000 combinations. Recommended for cooling and circulating and for booster service. Also general sump service. Self-priming. Available in standard column lengths of 5, 10, 15 and 20 ft.—with or without outer barrel. Capacities to 2600 gpm, heads to 300 ft.

double suction hot oil pump

Developed for capacities beyond the range of single suction process pumps. Designed to handle high temperature liquids on continuous service operation. Rotating element can be removed as a unit without disturbing the piping or driver. Capacity range from 1000 to 7000 gpm, heads from 100 to 700 feet. Construction materials to suit application.

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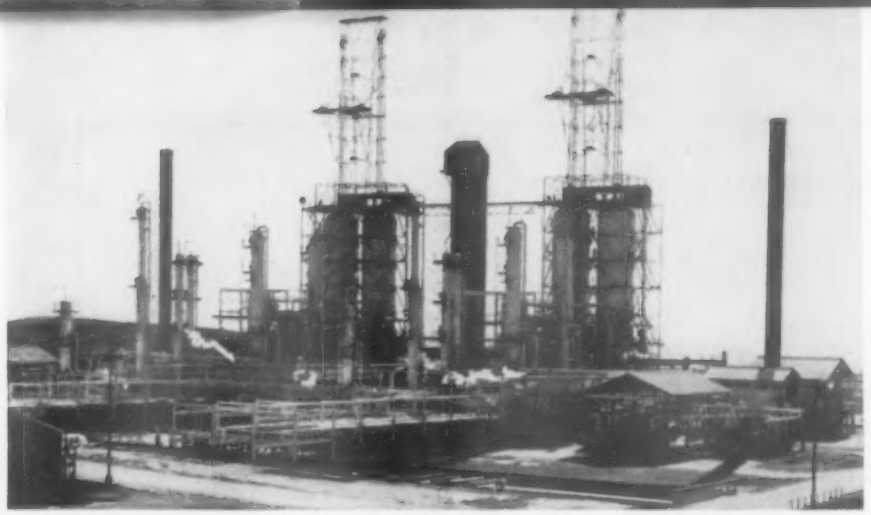
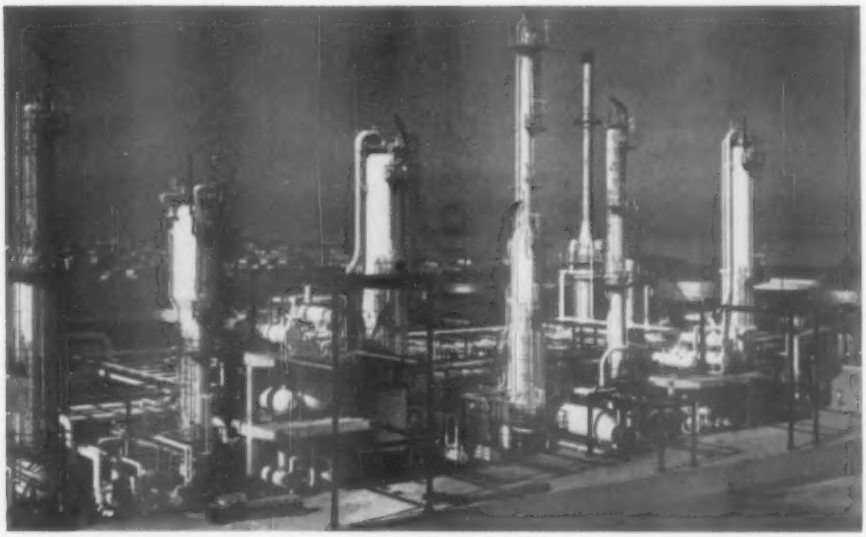


SANTA MARIA

How Union Gets Top Octanes



OLEUM

From Two California Plants

. . . from heavy crude base stock

In 5 years, Union's crude-oil runs increased by one-third and gasoline production increased from 38.6 per cent of the crude to 43.7 per cent. Expansion of processing facilities over this period was directed toward (1) reduction of fuel-oil production, and (2) increase in quality and quantity of gasoline. Realization per barrel of product sold increased 10 per cent during the 5 years.

by John M. Deal
Union Oil Co.

THE Oil Producers Agency of California, in statement recently filed with the Federal Power Commission, pointed out that yields of residual fuel oil dropped from an average of 38.1 per cent of California crude runs in July 1948 to 30.7 per cent in July 1955.[1] Improved refining techniques, involving greater use of coking and catalyst cracking to swing the balance toward gasoline and away from residuals, are in large measure responsible for this significant change.

A specific illustration of the marked improvement possible in yield structure, as well as quality of product through changes in refining techniques, is the recently completed refinery-construction program of Union Oil Co. of California. This article outlines some of the highlights of that program.

Major expansion . . . During the period from June 1950, when ground was broken for the first new unit to April 1955, when last unit started operating, Union completed a $70,000,000 expansion program at its several refineries. Among the major facilities involved was an entirely new refinery near Santa Maria, Calif., to perform first-stage processing on the low-gravity, high-sulfur crude oil produced in that area.

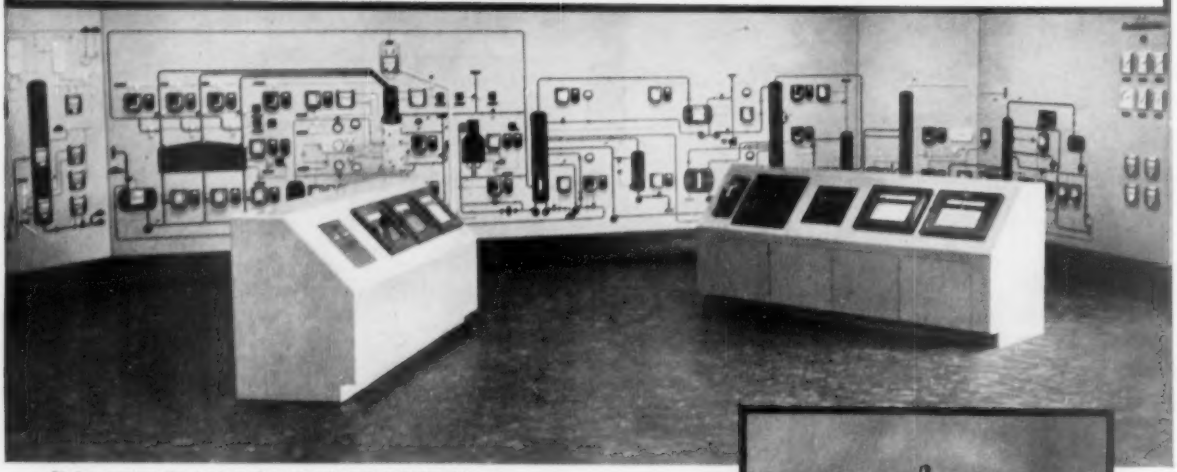
At the existing Los Angeles refinery, a 28,500-bbl. per day fluid catalytic cracker; a 40,000-bbl. per day crude-topping and vacuum distillation plant; a cracked-gasoline acid-treating and redistillation unit; a completely revamped butane isomerization unit; and a sulfur unit were all put on stream.

At Oleum refinery, on San Francisco Bay, new process units consisting of a 17,500-bbl. per day gasoline Unifiner; a 14,500-bbl. per day Platformer; a 6,500-bbl. per day Unisol treater; an amine-gas-treating unit, and a sulfur plant were all successfully completed and placed on stream.

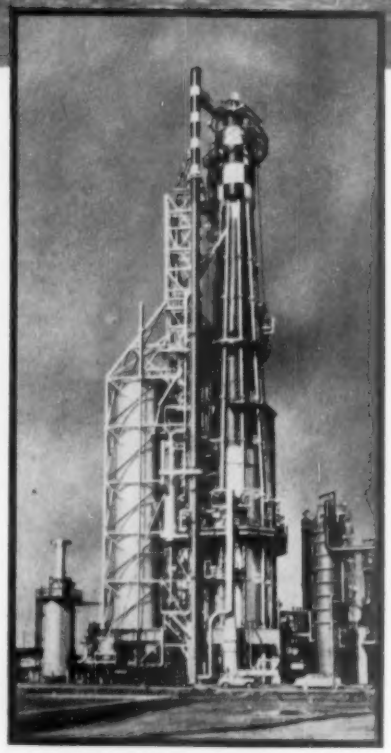
At the same time a modern concrete wharf and marine terminal were completed at Oleum refinery. Finally, Union's asphalt and road-oil potentials were increased by the construction of a new steam-distilled asphalt refinery, now being expanded, at Edmonds, Wash.; and the purchase of an asphalt and road-oil refinery (Orcutt refinery) near Santa Maria.

As a result of this program, Union's total crude-oil runs in the first half of 1955 were one-third higher than in 1950. Even more significant, however, is the fact that in 1950 Union's gasoline production was only 38.6 per cent of the crude, while in 1955 it is 43.7 per cent; and, in 1950 fuel oil was 37 per cent of the crude, while it presently

"American-Microsen" Electronic Control chosen by PETROFINA on proved performance



Photos courtesy The Lummus Company, New York, N. Y. and Canadian Petrofina Ltd., Montreal, P. Q.



This is the new refinery of Canadian Petrofina, Ltd., at Point aux Trembles, Quebec. Located here is the first Catalytic Cracking Unit in the Western Hemisphere to be operated by the "American-Microsen" Electronic Process Control System. It is the latest of hundreds of installations that have proved the reliability and practical advantages of "American-Microsen" control for refineries and chemical plants.

This Petrofina installation demanded long-distance transmission and difficult control applications, but start-up was completed ahead of schedule—to the benefit of refinery and contractor. *And the installed cost of the instruments was the same as for conventional controls.*

The long list of successful "American-Microsen" applications includes plant-scale operation of numerous critical petroleum and chemical processes. Conventional instruments could not control some of these processes, but they are handled easily by "American-Microsen" because of its speed of response, sensitivity and lag-free transmission. Many of these installations have been functioning well over a year, without maintenance problems, and with the enthusiastic approval of users.

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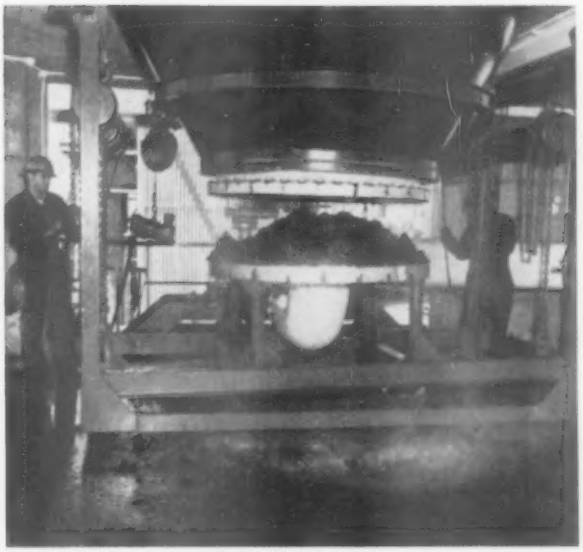
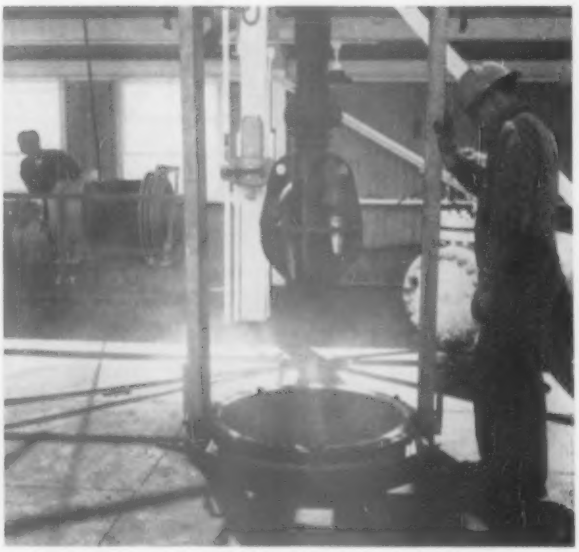
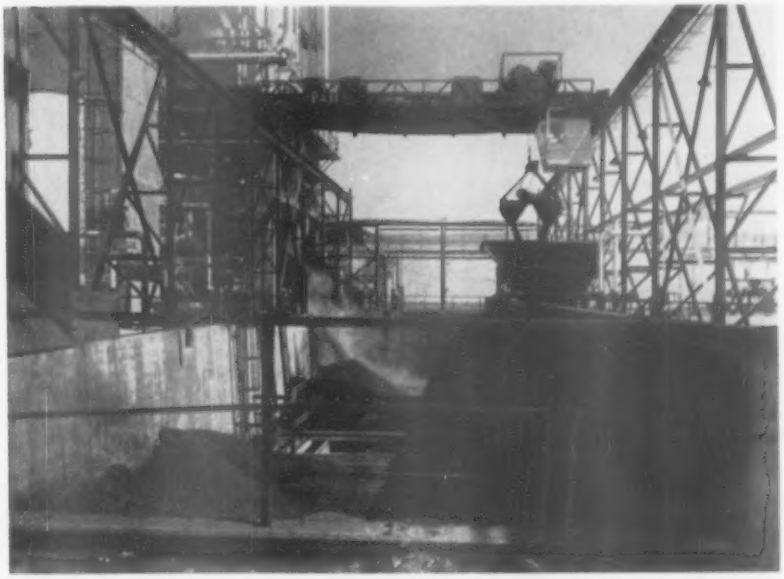


COKE REMOVAL requires steaming and water flooding. Then the bottom is dropped from a coke drum and moved to one side.



DECOKING is started by drilling a pilot hole through coke bed with water at 2,000 psi. A drilling tool is entering a drum.



COKE FROM DRUM enters a coke pit and water drains off through a system of sumps. Dry coke is then moved to a hopper feeding a conveyor.

is less than 29 per cent. Excluding the effect of price increases, the average realization per barrel of product sold during the first 6 months of 1955 was 10 per cent above 1950.[2]

Santa Maria Crude Program

Perhaps the most interesting portion of the over-all refinery expansion program concerns the units primarily installed to improve realization from Santa Maria type crude. These facilities consist of a new refinery and process units which will be discussed in some detail. First, however, consider the crude material at hand, and the contrasting product quantity and quality from the old and new processing techniques.

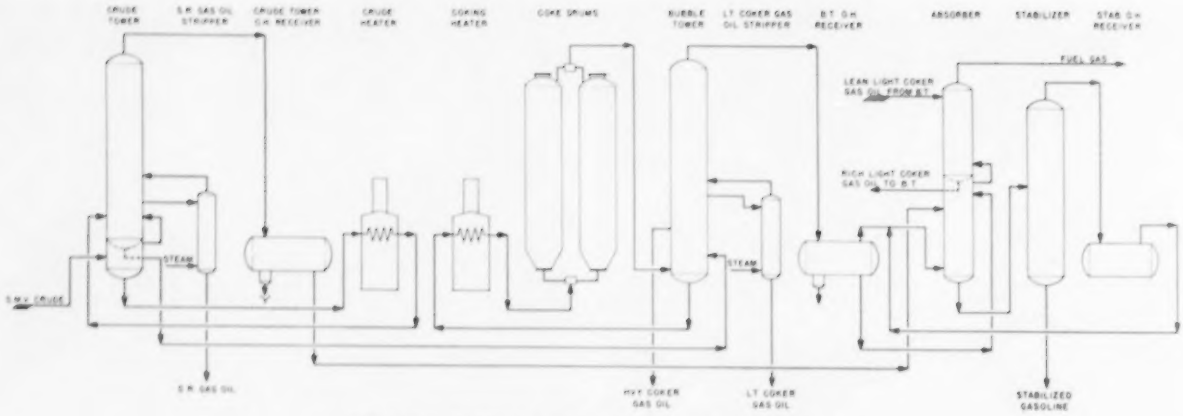
The Santa Maria area lies on the coast of California about 170 miles north of Los Angeles. Production from the Santa Maria Valley and associated fields is presently about 32,000 bbl. per day, of which over two-thirds is processed by Union Oil Co. Analysis of a typical composite crude sample (Table 1) shows it to be about 15° A.P.I. and over 5 per cent sulfur; some areas of the district contribute crudes running only 8° A.P.I. and as high as 6.5 per cent sulfur.

TABLE 1
Typical Santa Maria Valley Type Crude Charge to Santa Maria Refinery

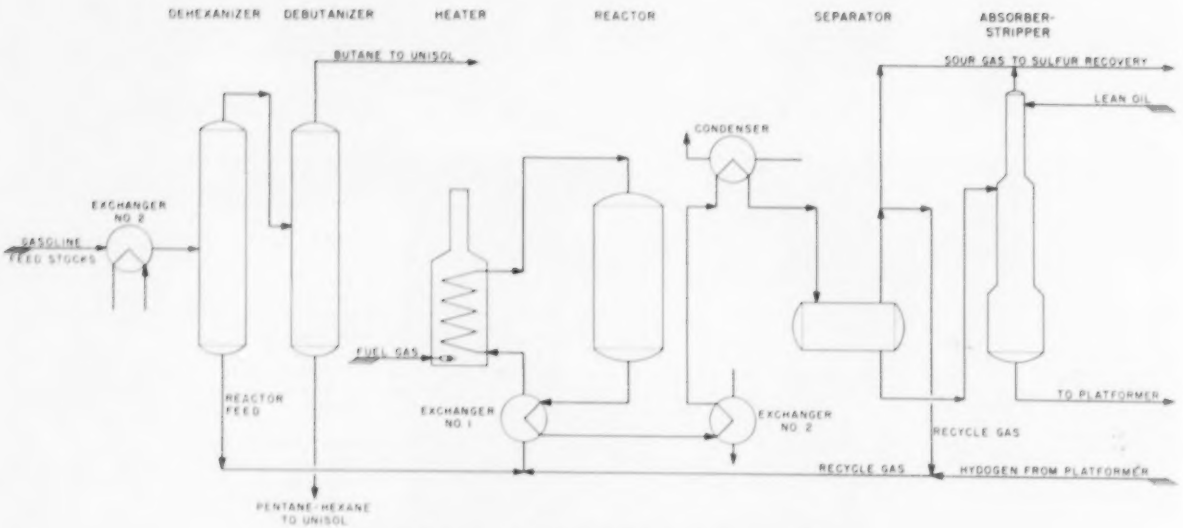
Gravity, °A.P.I. at 60° F. (dry)	15.0
Water by distillation, per cent	1.2
Pour point, °F.	15
Viscosity, S.s.F. at 122° F.	240
Flash, PM, °F., below	70
Sulfur, wt. per cent	5.32
Distillation, vol. per cent dry	
400° e.p. gasoline	13.3
Residuum	86.7
Properties of fractions	
400° e.p. gasoline	
Gravity, °A.P.I.	53.6
Knock rating	
Clear, motor	56.0
+3ml., motor	71.0
Sulfur, wt. per cent	0.61
Residuum	
Gravity, °A.P.I.	10.2
Viscosity, S.s.F. at 210° F.	90
Sulfur, wt. per cent	5.80

Before completion of the expansion program, Union's share of this production was topped and thermally cracked to yield gasoline and fuel oil except for a small percentage which was (and is) steam-distilled for asphalts and road oils. The topping and visbreaking operation, carried out at Oleum refinery, yielded only about 13 per cent usable gasoline stock and over 83 per cent fuel oil. Acid and doctor treatment of the raw gasoline decreased the yield to only 12 per cent of the crude; the research octane rating was approximately 70 clear, 80 with 3 ml. of lead.

New scheme . . . This handling was radically changed following completion last April of all the new refining facilities involved in the expansion program. Now Santa Maria crude is sent to delayed coking units at the new Santa



DELAYED COKING UNIT, Santa Maria refinery. Fig. 1.



UNIFINER PROCESS FLOW at the Oleum refinery. Fig. 2.

Maria refinery; straightrun and cracked gasoline and gas oil distillates are produced as the principal products from the coker and both are shipped, by pipeline and tanker, to Oleum refinery where the gas oil is thermally cracked for more gasoline, cutter stock and fuel oil.

Straightrun and thermal gasolines from all these operations amount to over 45 per cent of the crude; while fuel oil alone is only 11 per cent coke, gas, and mid-barrel products make up the rest of the crude.

The combined straightrun and thermally cracked gasolines, along with other gasoline stocks from elsewhere in the company, are processed in a combination Unifiner-Platformer unit, a catalytic desulfurization and reforming facility, to produce 97 (F-1 + 3 ml. TEL) octane blending stock. This represents a truly significant change in quantity and quality of product from a given crude feed.

Refinery Processing

The Santa Maria area was selected as the best location of a coking-plant refinery because of transportation economies, desirability of a close diluent source for field operations, and coke-storage possibilities.

The property consists of 3,200 acres located in southwestern San Luis Obispo County, approximately 14 miles northwest of the city of Santa Maria. It is bounded at two points on the east by California State Highway 1 and by the ocean on the west.

The Southern Pacific Railroad mainline coastal route bisects the property providing approximately 1,000 acres (in which all present development is located) on the east, and 2,200 acres on the west.

Summit pump station of the existing Union Oil Co. northern division pipeline system is approximately 6 miles to the east. A new line to supply the Santa Maria refinery with crude was extended from this station to the refinery.

Port San Luis at Avila, approximately 15 miles to the north, from which Santa Maria crude previously was shipped by tanker to Oleum refinery, now receives the distillate products from the new coking refinery by pipe-

THE AUTHOR

John M. Deal is process supervisor in the engineering and construction division of the manufacturing department, Union Oil Co. He has been associated with design and construction activity since joining Union in 1942. During the construction program described in this article, he functioned as program supervisor for the Oleum refinery work. A chemical-engineering graduate of University of Washington, he is a registered professional engineer in California.

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PLATFORMER PROCESS FLOW at the Oleum refinery. Fig. 3.

line for movement to Oleum refinery by tanker.

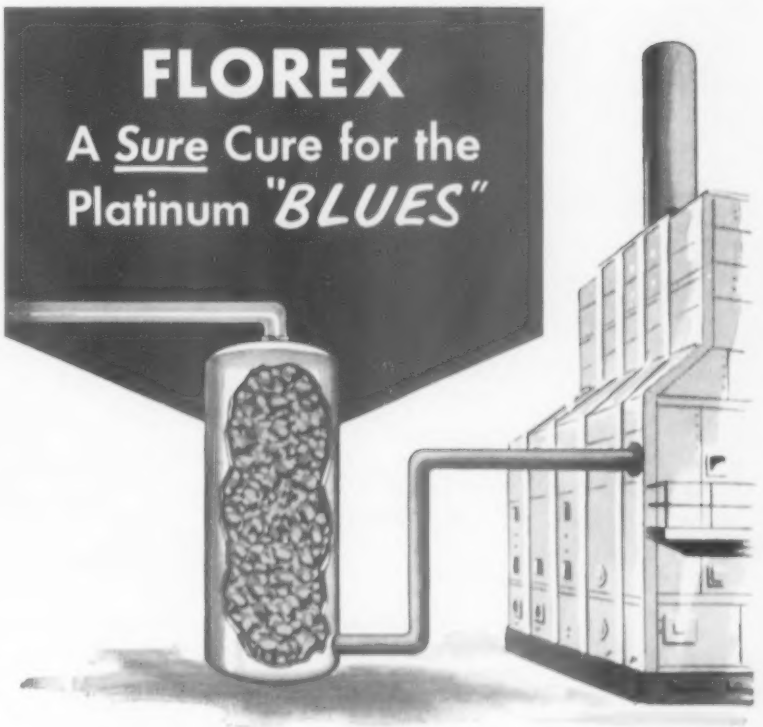
Coking units . . . The refinery consists of two delayed coking units and the necessary complementary facilities. To provide maximum operating and maintenance flexibility, identical twin coker units were provided. Not only do the two units make possible simultaneous operation on different crudes, or crude types; but by proper scheduling they also require relatively small maintenance crews to handle turnarounds. This is a real problem in this relatively remote area.

Independence of operation of the two cokers is carried to the extent that each plant is provided with its own blowdown and flare facilities. Only the control house, decoking jet water pumps, and part of the coke-handling section are common to the two units; these common facilities, however, do not change the feature of independent operation. Each coking unit has a design crude capacity of 10,500 bbl. per stream day, giving a combined plant capacity of 21,000 bbl. per stream day, or 18,900 bbl. per calendar day.

Fig. 1 is a simplified flow sheet of one of the twin cokers. About 10,500 bbl. per stream day of crude is preheated by exchange to over 300° before flashing into the lower section of the crude column. The flash-dehydrated reduced crude is then further heated by exchangers, plus a fired heater and again returned to the crude tower.

Full-range gasoline is taken overhead and sent to the light-ends towers for stabilization; straightrun gas oil is taken off as a sidecut to storage. Topped-crude-tower bottoms are transferred to the bubble tower, where it passes downward countercurrent to rising coke-drum vapors and becomes the coking-heater charge stock.

Decoking . . . Bubble-tower bottoms are charged to the coking heater; and coking heater effluent passes to a set of coke drums. In the conventional manner, one drum is on reaction and the other is being decoked. Feed enters the bottom of the drum, a liquid



The growing use of platinum catalysts in reforming feed stock emphasizes the importance of pre-removing trace metals such as arsenic, lead and sulphur compounds. Platinum catalysts are poisoned by these substances in quantities even as small as ten parts per billion.

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fraction remains in the drum where it gradually cokes, and vapors pass out the top.

Coke-drum vapors proceed to the bubble tower. From it, a heavy and light coker gas-oil stream, about equal in size, are produced. Bubble-tower overhead proceeds to the gas plant where an absorber and stabilizer remove propane and lighter materials, including hydrogen sulfide, from the raw gasoline material which is shipped on to Oleum refinery. Table 2 presents a material balance and some of the pertinent properties of the products from the Santa Maria refinery.

The coke drums are approximately 18 ft. in diameter by 80 ft. high. There are two drums for each of the twin coker units, four drums in all; each has a maximum capacity of about 350 tons of coke. One drum is decoked every 12 hours, with approximately 4 hours being required for the removal of coke from the drums by the high-pressure water jets. The remainder of the time is spent in cooling, opening, closing, and preheating.

The high-pressure-water jet-drilling and cutting tools are attached to a hollow drill stem which is connected to the center of the drill-derrick structure over the top of the coke drums. Water is supplied at 2,000 psi. and 1,000 g.p.m. by the jet water pumps.

The filled drum of coke is cooled and unheaded; the first operation in decoking is to drill a small pilot hole completely through the mass of coke with the drilling tool. The cutting tool is then attached to the drill stem and removal of the mass of coke from the drum begins. Loose coke and cutting water fall from the bottom of the drum through a detachable chute into a fixed chute and then into a large coke pit.

A grab-bucket bridge crane travels over the coke pit and removes coke from the pit and deposits it into a hopper. This in turn feeds a transfer conveyor belt carrying coke to the coke-storage area. Included in the transfer conveyor is a weightometer which weighs and records the tonnage of coke passing through and is the means for measuring coke production. The coke pit is sufficiently large that it can hold several drums of coke; consequently, removal of coke is done entirely on day shift.

Water drains out of the coke mass in the coke pit through a series of four settling sumps. Periodically, the bridge crane removes fines from the settling sumps and sends them to storage on the transfer conveyor. Water from the sumps is pumped to a cooling pond after which it is returned to the jet water system for reuse.

Data reduction . . . One unique feature of the Santa Maria refinery especially worthy of comment is a data reduction system incorporated in the two coking units at the common control house. This system utilizes a large electronic instrument roughly 43 in. high by 25 ft. long. It receives an electronic or pneumatic signal from some 150 temperature, flow, level, and pressure-sensing devices in each coker unit.

Through a series of transducers, relays, and other electronic components,

TABLE 2
Typical Properties of Products of Santa Maria Refinery

1. Crude charge rate, bbl./day	21,000
2. Combined S. R. and cracked gasoline stocks	
Volume per cent of crude charge	41
Boiling range, i.b.p.-e.p., °F.	102-490
Gravity, °A.P.I.	48.5
Sulfur, wt. per cent	1.95
Reid vapor pressure, psi.	7.5
3. Combined S. R. and coker gas oil	
Volume per cent of crude charge	39
Gravity, °A.P.I.	23
Sulfur, wt. per cent	3.85
Conradson carbon, per cent	0.15
Viscosity, S.s.F. at 122° F.	40
Boiling range, i.b.p.-e.p., °F.	484-740
4. Coke	
Weight per cent of crude charge	14
Volatile combustible matter, per ct.	12
Ash, per cent	0.4
Sulfur, per cent	5.3
5. Sulfur, long tons/day	43

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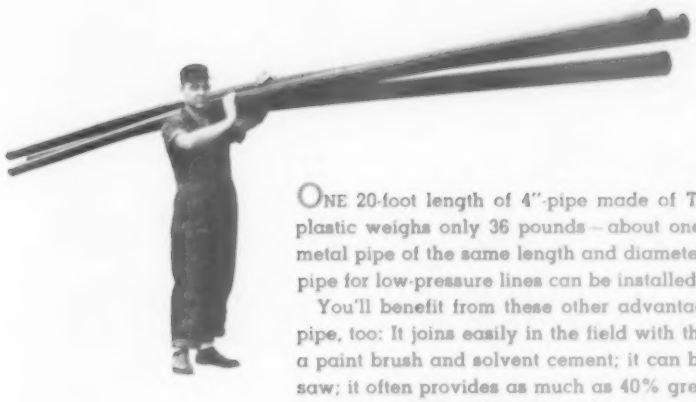

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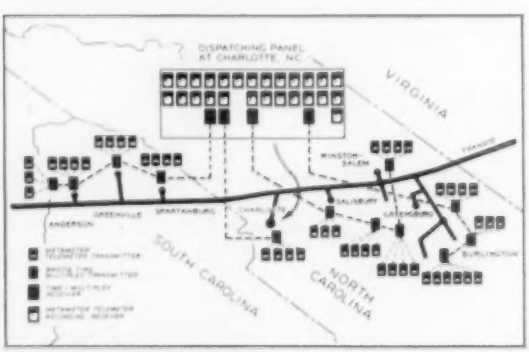

TWO-STATE COVERAGE with only four leased telephone circuits is effected by this instrumentation system. Note that as many as four intermediate time-multiplex transmitters add readings to a single circuit at different points.

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these impulses are translated into recording and monitoring signals. Two electric typewriters, one for each unit, are utilized to maintain printed log sheets of operations. Every 2 hours a complete set of readings is taken and logged in the log sheets over a period of 8 to 10 minutes.

When the machine is not logging, automatically it scans all of the variable points. Should any control point get outside a preset range, an alarm will be sounded to alert the operator; and the point outside the control range is automatically printed on log sheet in red.

The data-logging system is an aid in operation of the unit. Continuous scanning prevents many upsets before they occur; and the data recorded during an upset are valuable for later analysis. The advantages of releasing manpower for a tedious, routine task such as logging data are obvious.

Sulfur plant . . . Aside from the coker, the only other processing unit at Santa Maria refinery is the combined hydrogen sulfide removal and sulfur plant. Diethanol amine solution (D.E.A.) is used to absorb hydrogen sulfide from the dry fuel gas stream at atmospheric temperatures; the "rich" D.E.A. is then heated to elevated temperatures to strip the hydrogen from the solution.

The hydrogen sulfide stripped out passes to a modified Claus-type sulfur unit, where it is converted into elemental liquid sulfur. The combined plant will treat approximately 5 million standard cubic feet per day of gas containing 23 per cent hydrogen sulfide; and give an over-all sulfur yield of over 90 per cent. A second sulfur plant is now under construction.

Fresh water for the refinery is supplied by two water wells drilled on the property, each of high enough capacity that it alone can meet normal refinery water demands with relative ease.

The refinery boiler plant includes three 33,000-lb. per hour factory-built package boilers producing 450-psig. steam at 460° F. They have operated entirely satisfactorily on 100 per cent oil and 100 per cent gas; normally, fuel gas is used.

The fire-protection system includes a 55,000-bbl. raw-water storage tank, a complete refinery main fire loop system, a fully automatic gasoline-engine-driven fire pump rated at 1,500 g.p.m and 150-psi. pressure, a manually operated gasoline-engine-driven standby fire pump of the same capacity, and two auxiliary industrial water pumps to maintain 100-psi. pressure on the fire main loop and to provide 300 g.p.m. each for plant industrial water requirements. Dry foam powder is used when needed for fire fighting.

The effluent treating system treats refinery waste waters for final disposal to the ocean. A waste process water stripper is included in each coking plant for removal of sulfides and cyanides; sulfur stripping plus oil separation through a conventional A.P.I. separator provided in the effluent treating area makes the refinery waste water safe to dispose in public waters.

Treated waste water is pumped 2½ miles to the ocean through a 12-in. line, discharge point of which is carried 1,000 ft. beyond mean low water.

Fume and odor control . . . Santa Maria refinery has gone to great lengths for most effective control of fume and odors. In addition to the sulfide stripper on coking-plant waste waters and the circulating amine system—hydrogen sulfide removal unit and sulfur-production plants, the following facilities have been provided for maximum control of fume and odors:

1. Standard vapor and leakage conservation techniques, such as floating-roof tanks for crude oil and low flash products, and mechanical seals on process pumps, were used throughout.

2. Steam and oil vapors from steam-out of the coke drums prior to their opening for decoking are led through

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a condensing vessel containing shower decks where they are scrubbed with circulating water streams to condense the steam and remove all condensable hydrocarbons. The fixed gas vapors are then burned in smokeless flare burners.

3. Process unit relief valve discharges are treated to recover oil, the vapors finally also passing to the smokeless flare.

4. Twin sulfur plants are also being provided to give a maximum degree of flexibility to operation of the unit on high-sulfur crudes and to permit servicing one sulfur plant without shutting down the refinery because of air-pollution reasons.

Oleum Refinery Process Additions

The two liquid products from Santa Maria refinery, combined gasolines, and combined gas oils, are shipped on to Oleum refinery for further processing. There gas oils are thermally cracked in an existing thermal cracking unit for more gasolines, fuel oil, and fuel-oil cutter stock.

The combined gasolines are redistilled to remove any contaminants picked up in transit; and finally all Santa Maria stock gasolines are joined with other gasolines and upgraded to high-quality blending stocks in new process units constructed as part of the over-all expansion program.

Unifiner-Platformer . . . The most important new units provided at Oleum refinery are the Unifiner - Platformer combination for catalytically upgrading high-sulfur, low-octane gasoline and naphtha stocks. The Unifiner, a process developed and licensed by the research department of Union Oil Co. for catalytic desulfurization and nitrogen removal, acts primarily as a feed-preparation unit for the Platformer.

Gasolines from the following sources are presently processed in the Unifiner: (1) The Santa Maria coker; (2) a similar coker operating at the Oleum refinery on low-sulfur residual oils; (3) thermal cracking of the gas oils produced at the Santa Maria refinery; (4) thermal cracking of low-sulfur gas oil; and (5) high and low-sulfur straight-run gasolines from many sources within the company. All these stocks, depropanized at source, are mixed together and processed in the Unifiner unit (flow is shown in Fig. 2).

The charge is first preheated by exchange with reactor effluent, and then topped of its lighter fractions in a dehexanizer tower. Hexane and lighter materials are removed, split into two separate streams (butanes and a C_5-C_6

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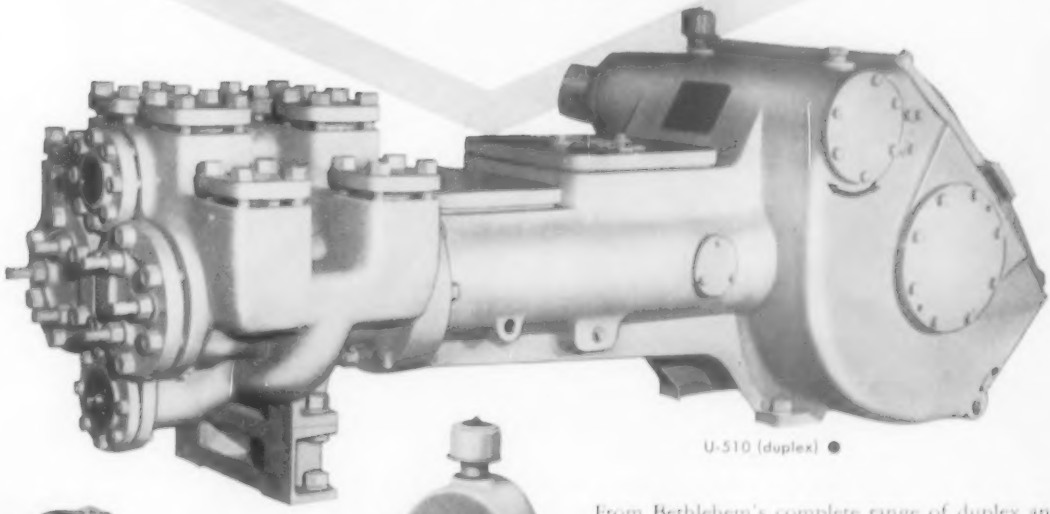

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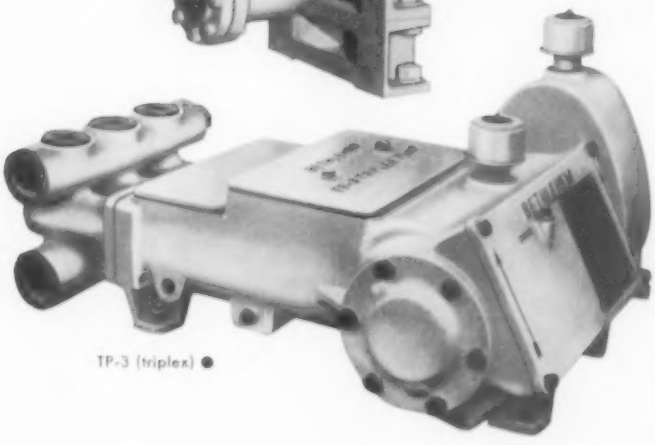

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U-510	Duplex	100	3 to 5½ x 10

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stream) in a debutanizer, and the two streams are sent to the Unisol plant where solvent treatment removes the impurities.

Dehexanizer bottoms become reactor charge; they are mixed with hydrogen-rich recycle gas, preheated by exchange with reactor effluent, passed through a fired heater, and then enter the reactor. In the reactor, selective hydrogenation effects essentially complete denitrogenation, desulfurization, and olefin saturation.

Material from the reactors passes through several heat exchangers, a condenser, and then enters a separator. Most of the gas from the separator is recycled to contact fresh feed, and the net surplus from the unit is produced to the sour-gas system of the refinery. Net hydrogen makeup is supplied by the Platformer.

Liquid from the separator is stripped of material (including H_2S) lighter than butane in an absorber-stripper tower before passing on as feed to the Platformer. Prefractionator bottoms from the Platformer serve as lean oil for the absorber.

Unifining results . . . The Unifining catalyst was first described by Grote et al[4]. It has performed well in the Oleum refinery. Table 3 lists properties of a typical feed and product. Sulfur and nitrogen removal are 99.2 weight per cent and 99.8 weight per cent respectively. Equally good performance has been experienced on feeds containing as high as 1.75 per cent sulfur and 220 p.p.m. basic nitrogen.

Platformer . . . Stocks from the Unifiner unit are charged to the prefractionator tower in the Platformer (see Fig. 3 for the simplified flow plan of this unit). Material of 380° F. e.p. is distilled overhead to become the reactor charge, while bottoms from the tower have proved to be excellent stove-oil and jet-fuel stocks. Platformer reactor charge is mixed with a hydrogen-rich recycle gas, heated by exchange with reactor effluent, and further heated in a fired heater to the design reactor charging temperature.

It then enters the first of three reactors, containing platinum catalyst. Platforming reactions, principally dehydrogenation of naphthenes, hydrocracking of paraffins, and isomerization, are endothermic[5], so fired interheaters bring the effluent from each reactor back up to the correct temperature before it passes it on to the next one.

Hydrogen-rich gas from the separator recycles back to meet more reactor charge; the operating excess passes on to the Unifiner for its needs. Liquid from the separator drum is stabilized

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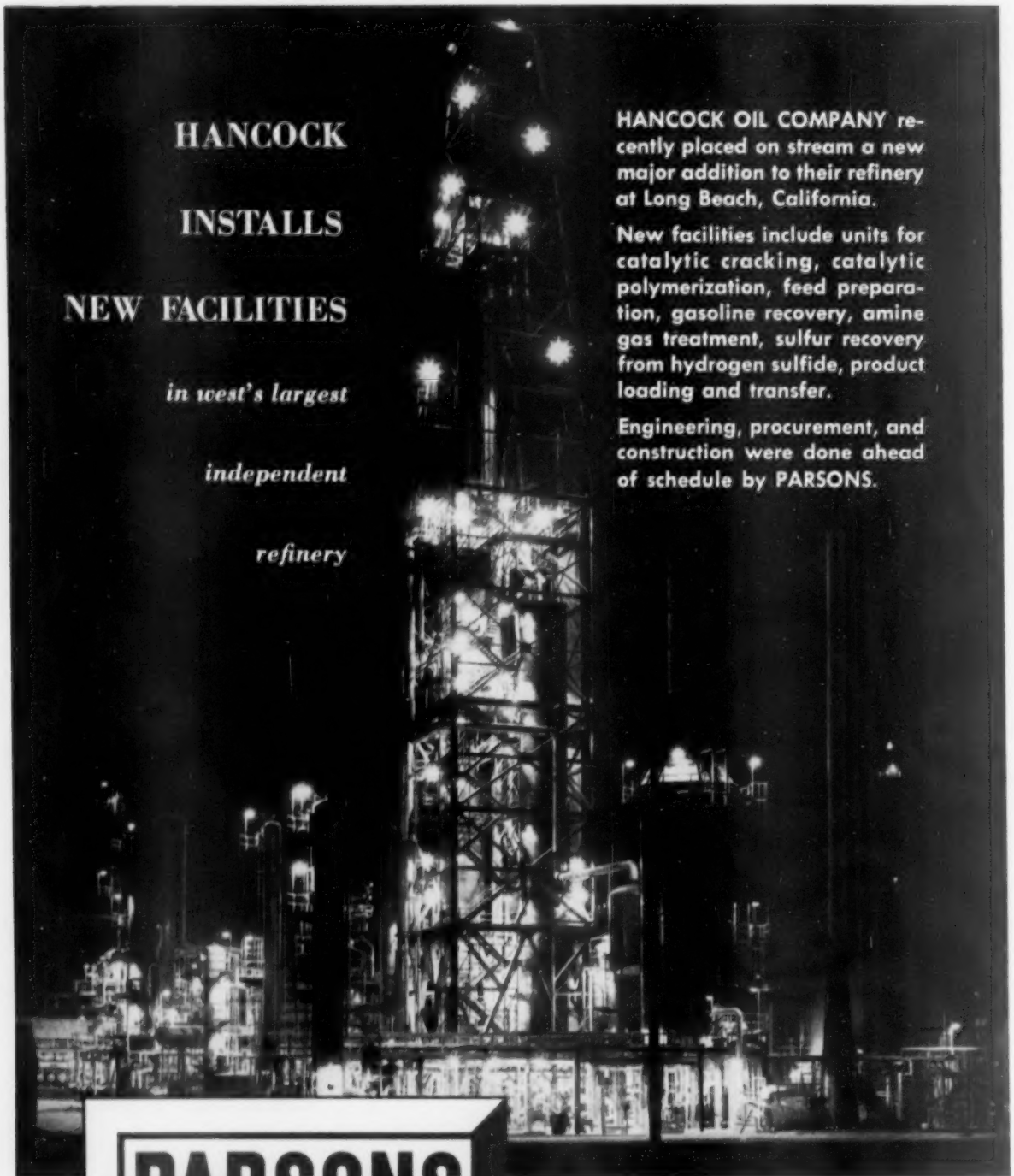

HANCOCK INSTALLS NEW FACILITIES

in west's largest independent refinery

HANCOCK OIL COMPANY recently placed on stream a new major addition to their refinery at Long Beach, California.

New facilities include units for catalytic cracking, catalytic polymerization, feed preparation, gasoline recovery, amine gas treatment, sulfur recovery from hydrogen sulfide, product loading and transfer.

Engineering, procurement, and construction were done ahead of schedule by PARSONS.

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TABLE 3
Feed and Products of Unifiner Unit Oleum Refinery

1. Feed.	
°A.P.I.	46
Total sulfur, wt. per cent	1.2
Basic nitrogen, p.p.m.	165
Boiling range, i.b.p.-e.p., °F.	230-455
2. Product	
°A.P.I.	48.8
Total sulfur, wt. per cent	0.010
Basic nitrogen, p.p.m.	0.3
Boiling range, i.b.p.-e.p., °F.	193-465

and fractionated into light and heavy platformate. At the present time depropanized full-range platformate is running approximately 97 octane, when leaded with 3 ml. of TEL.

The combination of Platformer-Unifiner as a method of improving low-quality gasoline stocks has proved to be extremely successful in Union's operations. After running in a completely trouble-free manner from the original startup in January 1955, the two units were shut down and thoroughly inspected in mid-October 1955.

Essentially no corrosion or fouling was noticeable in any portion of either unit; catalyst changes were unnecessary. Operating life of the Platformer catalyst has proved to be well above that guaranteed; and it is believed this has been achieved in great part through the excellent desulfurization and nitrogen-removal operations at the Unifiner.

In addition to the platformate produced from the Unifiner - Platformer combination, two additional gasoline blending stocks are made. One is a butane-butylene cut, and the other, a pentane-hexane cut.

These streams are individually treated in separate sections of a new Unisol treating plant.

As at Santa Maria refinery, it was also deemed desirable at Oleum to provide a circulating amine system and a sulfur plant to remove the hydrogen sulfide gas produced by cracking and hydrogenating high-sulfur stocks from the refinery fuel gases and convert it to elemental sulfur. Sulfur production is presently about 40 tons per day.

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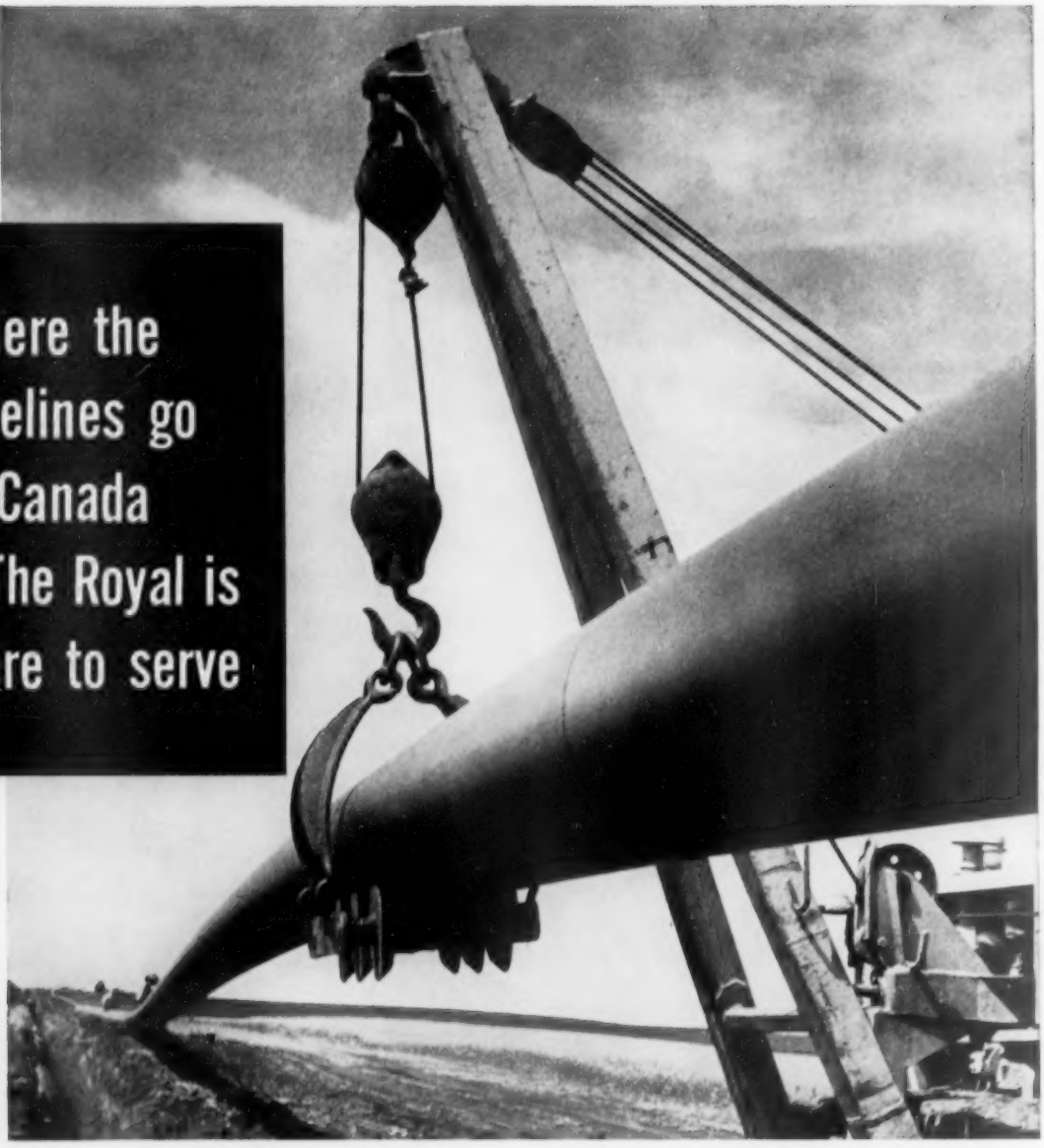
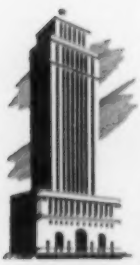


Canada's largest bank has grown with Canada's oil industry from the earliest days of gas and oil development.

A branch of this bank opened in Turner Valley back in the late 20's. The important Leduc discoveries occurred in 1947; the "Royal" branch at Leduc opened the same year. Devon and Redwater branches followed in 1949. The Royal Bank was the first to open a branch in Alberta's new Pembina field back in the early months of 1954. All told, there are more than 280 branches of this bank strategically placed throughout Canada's oil and gas rich western provinces.

Canada's largest bank has well earned its familiar unofficial name—"Canada's Oil Bank". Whatever phase of the industry you're engaged in, you'll find many advantages in making it *your* bank, too.

We do not provide information on oil securities.



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Journal Survey of Refineries in the United States

...DISTRIBUTION AND CAPACITIES AS OF JANUARY 1, 1956

(Capacity, barrels per stream day)

State—	No. plants	Crude capacity	Vacuum dist.	Thermal operations	Catalytic cracking	Cat reforming	Hydrogenation	Alkylation	Polymerization	Lubes[1] (bbl.) Coke[2] (tons)	Asphalt
Alabama	4	14,200	8,700								11,200
Arkansas	6	82,000	28,300	13,500	36,000	8,000		2,650	700	[1]3,450 [2]400	7,000
California	39	1,269,850	477,540	514,515	387,510	135,475	98,000	47,018	4,580	[1]20,610 [2]2,250	58,675
Colorado	7	35,650	9,700	9,250	12,500				450		1,500
Delaware	1	3,885	1,943								1,665
Florida	1	2,000									1,100
Georgia	1	7,000									3,500
Illinois	13	543,400	122,835	164,215	249,800	75,725	37,085	25,104	10,434	[1]4,923 [2]1,754	25,622
Indiana	9	458,700	68,990	178,450	167,355	48,600	6,050	8,210	4,742	[1]9,950 [2]1,370	12,270
Kansas	14	292,500	86,300	62,000	169,750	14,500		2,400	8,350	[1]3,500 [2]335	20,300
Kentucky	4	81,500	36,500	21,500	28,800	6,400	8,500		3,250		9,500
Louisiana	15	752,000	234,600	136,500	398,280	63,250		36,100	9,745	[1]18,750 [2]385	14,150
Maryland	3	79,500	33,500	10,000	60,500	3,000	17,000	4,580		[2]350	22,700
Massachusetts	1	55,000	13,500	15,000	24,500				1,600		10,000
Michigan	15	156,200	23,500	29,100	57,500	19,400	6,700		2,620	[2]190	8,050
Minnesota	4	54,000	9,000	10,000	39,000	5,000	11,000		2,020	[2]450	
Mississippi	2	11,100	5,100	2,000					150		3,600
Missouri	1	76,000	7,200	50,000	32,000	14,000			1,800	[2]505	4,000
Montana	11	70,680	18,600	20,000	46,500	3,100	7,800		2,966	[2]210	9,700
Nebraska	2	3,200		1,000		650					
New Jersey	6	452,800	156,220	47,990	199,850	23,320	30,000	6,176	9,775	[1]8,500	24,400
New Mexico	7	24,800	6,875	2,500	3,400	2,050	1,000		380		1,400
New York	5	105,870	21,000	14,700	58,000				3,200	[1]3,550	5,600
North Dakota	3	36,000		750	23,000	300			4,365		
Ohio	12	420,280	72,707	134,190	185,342	58,517	16,000	5,900	9,000	[1]4,300 [2]675	20,100
Oklahoma	18	366,150	98,290	103,240	179,050	38,520	8,880	10,740	9,635	[1]9,960 [2]1,210	13,278
Oregon	1	6,500	6,500								6,250
Pennsylvania	13	673,360	179,300	80,672	292,055	92,100	14,400	8,658	9,190	[1]31,358 [2]25	10,601
Rhode Island	2	3,885	1,943								8,165
South Carolina	1	8,700	6,800								4,500
Tennessee	2	7,000	1,000		3,100				250		
Texas	61	2,451,920	532,250	687,841	881,680	283,612	158,090	89,273	32,893	[1]64,730 [2]544	33,060
Utah	5	83,200	26,500	10,700	47,500			3,500	1,200	[1]120	2,900
Washington	4	95,500	32,500	6,600	42,000	14,000	8,000		4,800		8,200
West Virginia	2	7,300	1,500	2,850		2,500	500		175	[1]1,800	
Wisconsin	2	11,000	5,000	1,500		3,500			100		4,500
Wyoming	14	118,545	32,490	24,755	44,460	7,250	4,000	2,500	1,880	[1]650 [2]229	11,904
Puerto Rico	2	37,000	26,000		39,900	3,700		1,400	1,400		
Total	313	8,958,175	2,392,683	2,355,318	3,709,332	926,469	433,005	254,209	141,650	[1]186,151 [2]10,882	379,390

Refining Capacity Presses 9 Million Barrels

by LaWanda Turner
District Editor

UNITED STATES refineries boosted their capacities by 3.7 per cent during 1955, from 8,639,000 bbl. per day on January 1, 1955, to 8,958,000 on January 1, 1956.

Catalytic cracking capacity increased by 420,000 bbl. during the year. Data on catalytic cracking have been expanded this year, due to requests from many refiners. The plant-by-plant table now shows total feed and per cent recycle, based on total feed.

Catalytic reforming capacity jumped from 569,330 bbl. per day to 926,469 bbl. during the year, an increase of 63.3 per cent. Ratio of catalytic reforming capacity to crude-charge capacity now stands at 10.3 per cent. On January 1, 1955, it was 6.6 per cent.

The biggest gain percentagewise that was registered in 1955 was in hydrogen treating. Capacity jumped from 116,700 to 433,000 bbl. per day during the year. This is an increase of 272 per cent!

Vacuum distillation capacity rose from 2,065,000 to 2,392,683 bbl. during the year. This additional capacity of 328,000 bbl. amounts to a 15.8 per cent increase. Alkylation capacity was increased by some 24,000 bbl. per day during the year, and modest increases were registered in polymerization, asphalt, lube, and coke capacities. Thermal capacity dropped slightly.

Basis for survey . . . The Journal asks in its survey that each refiner report on a stream-day basis. Some refiners prefer not to do this and have reported on a calendar-day basis. These figures are reported as received in the plant-by-plant listings, **but they have been converted to a stream-day basis** for obtaining state and national totals.

Calendar-day figures are multiplied by 1.11 to convert to stream-day basis. These conversions are noted as they are made in the tables.

The figures in this table are based on capacities as of January 1, 1956. Immediately following is a survey of new construction for 1956 and later. To project probable near future capacity, add capacities from this table to those in the new construction table.

Figures in the supplementary table reflect additional capacity, taking into consideration the retirement of existing units in some cases.

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Report on United States Operating Refineries

. . . where, how, and how much

Processes identified by numbers. Here's what numbers mean . . .

THERMAL PROCESSES
1. Gas Oil Cracking
2. Visbreaking
3. Naphtha Reforming
4. Coking
5. Fluid Coking
6. Delayed Coking
7. Batch Coking
8. Residuum Cracking

CATALYTIC CRACKING AND PER CENT RECYCLE
(Per cent recycle based on total feed)
1. Fluid
2. Thermofor
3. Houdriflow
4. Houdry
5. Cycloversion

CATALYTIC REFORMING
1. Platforming
2. Hydroforming
3. Fluid-Hydroforming
4. Fixed-Bed Hydroforming
5. Houdriforming
6. Ultraforming
7. Catforming
8. Thermofor
9. Sinclair-Baker
10. Sovaforming
11. Hyperforming
12. Rexforming
13. Cycloversion
14. Powerforming

CATALYTIC HYDROGENATION
1. Unifining
2. Hydrofining
3. Hydrotreating
4. Hydrodesulfurization
5. Gulfining
6. Sovafining
7. Hydropretreating
8. Diesulforming

ALKYLATION
1. Sulfuric
2. Hydrofluoric

POLYMERIZATION
1. Thermal
2. Catalytic

LUBES AND COKES
1. Lubes (bbl.)
2. Coke (tons)

ASPHALTS
1. Straightrun
2. Oxidized
3. Other

ALABAMA

Company and location	Charge, bbl. per stream day: Crude capacity	Vacuum dist.	Thermal operations	Cat cracking—Feed	Cat cracking—Per cent	Cat reforming	Hydrogenation	Production: Alkylation	Polymerization	Lubes (bbl.)	Coke (tons)	Asphalt
American Bitumuls & Asphalt Co.:												
Mobile	6,000	6,000										[1]4,800
												[2]900
												[2]2,300
Hunt Oil Co.:												
Tuscaloosa	5,200	2,700										[1]1,100
												[2]300
Vulcan Asphalt & Refining Co.:												
Cordova	2,000											[1]1,200
Warrior Asphalt Corp.:												
Holt	1,000											[2]300
												[2]300
Total	14,200	8,700										11,200

ARKANSAS

Company and location	Crude capacity	Vacuum dist.	Thermal operations	Cat cracking—Feed	Cat cracking—Per cent	Cat reforming	Hydrogenation	Alkylation	Polymerization	Lubes (bbl.)	Coke (tons)	Asphalt
Berry Asphalt Co.:												
Stephens	2,000	1,200										[1]500
Waterloo	6,500	1,200									[1]500	[2]600
Henry H. Cross Co.:												
Smackover	6,000	1,200									[1]700	[1]700
Lion Oil Co.:												
El Dorado	27,500	14,200		[1]10,000	50			[1]1,150	[2]400	[1]1,000		[1]4,000
				[2]6,000	0							
Macmillan Petroleum Corp.:												
Norphlet	4,000	2,500								[1]1,250		[1]1,200
Pan-Am Southern Corp.:												
El Dorado	36,000	8,000	[1]3,500	[1]20,000	6.5	[4]8,000		[1]1,500	[1]300	[2]400		
			[4]10,000									
Total	82,000	28,300	13,500	36,000		8,000		2,650	700	[1]3,450		7,000
										[2]400		

CALIFORNIA

Company and location	Crude capacity	Vacuum dist.	Thermal operations	Cat cracking—Feed	Cat cracking—Per cent	Cat reforming	Hydrogenation	Alkylation	Polymerization	Lubes (bbl.)	Coke (tons)	Asphalt
Bankline Oil Co.:												
Bakersfield	8,000		[1]3,000									
Calstate Refining Co.:												
Long Beach			[2]2,500			[1]1,000						
Caminol Co.:												
Hanford	5,000	2,000	[1]500						[2]100			
			[2]1,500									
			[1]500									
Century Oil Co.:												
Signal Hill	5,000											
Douglas Oil Co. of California:												
Bakersfield	8,200		[1]4,600			[2]2,500						
Paramount	6,000											
Santa Maria	3,500											
Edgington Oil Refineries, Inc.:												
Long Beach	7,000											[1]1,500
												[2]1,000
Oxnard	2,500											[1]1,750

CALIFORNIA (Continued)

Company and location	Charge, bbl. per stream day: Crude capacity	Vacuum dist.	Thermal operations	Cat cracking Feed	Cat cracking Per cent	Cat re-forming	Hydro-genation	Production: Alkylation	Polymerization	Lubes (bbl.)	Coke (tons)	Asphalt
Envoy Petroleum Co.:												
Long Beach	3,000											[1]1,000 [2]300 [3]700
Fletcher Oil Co.:												
Wilmington	5,000		[1]5,000									
General Petroleum Corp.:												
Torrance	128,000	38,000	[2]26,500 [5]26,000	[2]55,000	50	[5]16,000		[2]3,700	[2]600	[2]1,100		
Golden Bear Oil Co.:												
Bakersfield	3,000									[1]1,000		[1]800
Hancock Oil Co. of California:												
Signal Hill	14,000		[1]1,000 [2]6,000	[2]10,000	42				[2]500			
Macmillan Petroleum Corp.:												
Long Beach	8,000									[1]250		[1]1,800
Mohawk Petroleum Corp.:												
Bakersfield	11,000		[1]1,000 [2]2,500			[1]2,500						
Newhall Refining Co.:												
Newhall	3,000											[1]500 [2]250
Oxnard Oil & Refining Co.:												
Oxnard	1,800											[1]1,000
Palomar Oil & Refining Corp.:												
Bakersfield	1,300									[1]390		[1]520 [2]100
Richfield Oil Corp.:												
Watson	136,500	63,000	[1]25,000 [2]27,000	[1]63,000 [2]30,000	80 25			[1]6,000	[2]2,500			[1]2,000 [2]1,000
Rothschild Oil Co.:												
Santa Fe Springs	10,000		[1]5,000			[1]1,000			[2]150			
Seaside Oil Co.:												
Ventura	5,500	500										[1]500
Shell Oil Co.:												
Martinez	55,000	11,000	[1]30,000			[1]4,500				[1]3,100		[1]4,200
Wilmington-Dominguez	79,000	45,000	[1]36,000	[1]25,000	0	[1]3,500	[4]12,000	[1]5,500				
Socal Oil & Refining Co.:												
Huntington Beach	2,400		[1]1,800									
Standard Oil Co. of California:												
Bakersfield	*20,000		*[3]9,000									[1]1,230
El Segundo	*120,000	*54,000	*[1]11,000 *[3]59,000	*[1]36,000	10	*[1]30,000	*[1]20,000	*[1]5,400				[1]9,225
Richmond	*165,000	*25,000	*[2]7,500 *[3]50,000	*[2]32,000	0	*[1]20,000 *[4]12,500	*[1]20,000	*[2]4,000		*[1]10,000		[1]2,300
Sunland Refining Co.:												
Bakersfield	8,000		[2]1,100									
Sunset Oil Co.:												
Torrance	9,000		[2]2,700						[2]90			
Superior Asphalt Co.:												
Oxnard	1,500											[1]1,200
The Texas Co.:												
Wilmington	*60,000	*35,000	*[1]10,000	*[1]23,000		*[1]10,000	*[1]10,000	*[1]4,400				
Tide Water Associated Oil Co.:												
Associated	114,000	64,000	[1]17,600 [2]27,000	[1]40,000	0	[1]10,000	[1]10,500	[1]6,000		[1]1,670		
Union Oil Co. of California:												
Wilmington	117,500	84,000	[1]16,000 [2]18,500 [3]8,500	[1]35,000 [2]22,000	12 19			[1]4,500				[1]6,000 [2]1,000
Bakersfield	8,800											[1]1,950
Rodeo	45,200	27,000	[1]13,000 [5]13,500			[1]14,000	[1]20,000			[1]3,100 [2]500		[1]5,000
Santa Maria	5,000	1,500										[1]1,400 [2]450
Arroyo Grande	19,000		[5]15,100							[2]650		
Wilshire Oil Co., Inc.:												
Norwalk	25,000	15,000	[2]13,500	[1]6,500	10			[2]6,000	[2]640			
Total†	1,269,850	477,540	514,515	387,510		135,475	98,000	47,018	4,580	[1]20,610 [2]2,250		58,675

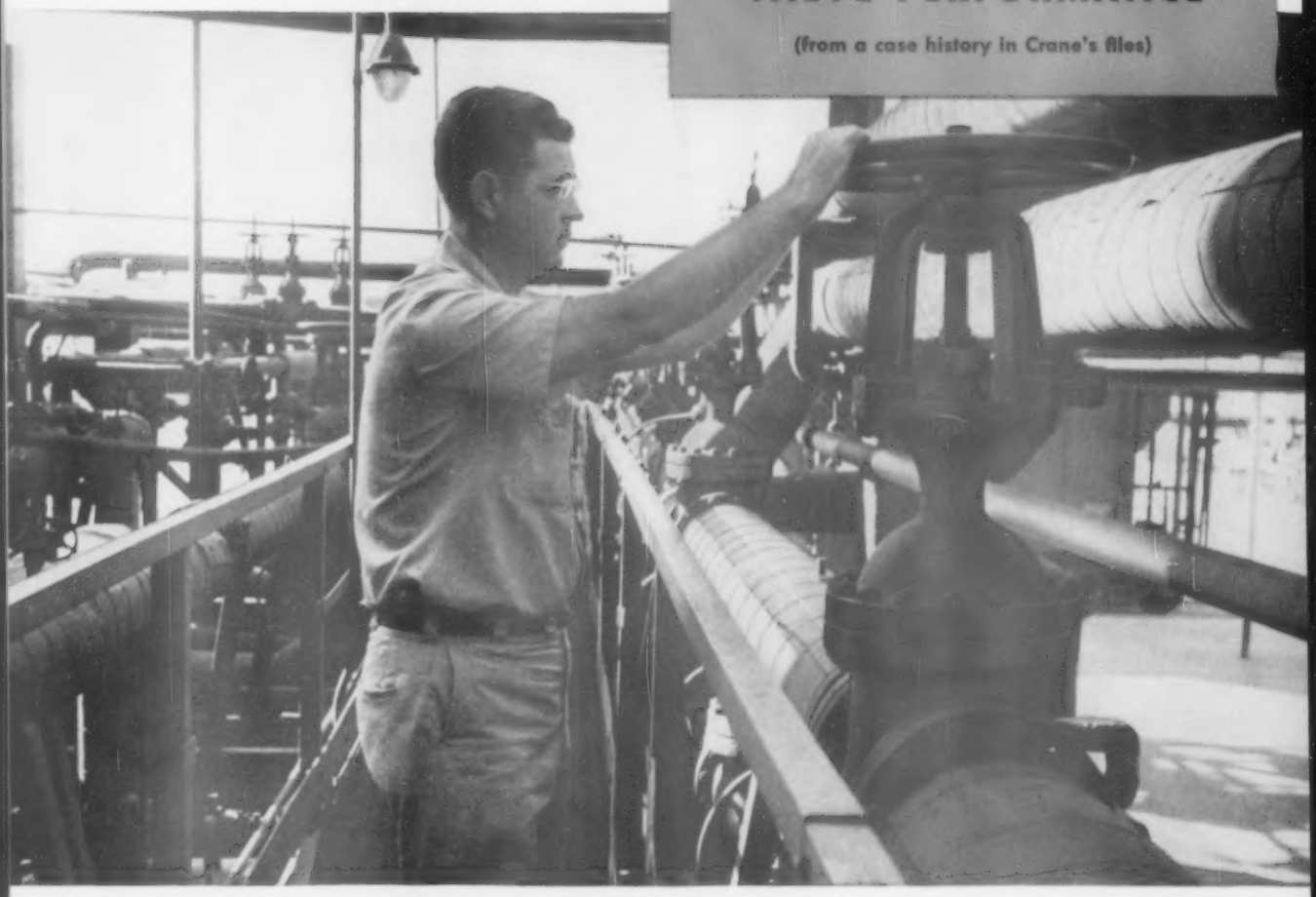
*Barrels per calendar day. †State totals include calendar day figures converted to stream day.

COLORADO

Bay Petroleum Corp.:												
Denver	10,500	3,000	[2]4,000	[1]6,000	33							
Continental Oil Co.:												
Denver	12,000	4,700	[1]2,150	[2]6,500	37				[2]450			
Empire Petroleum Co.:												
Denver	5,000	2,000										[1]1,500
Oriental Refining Co.:												
Alamosa	1,000		[1]600									
Denver	3,500		[1]1,500									
Skelly Oil Co.:												
Denver	1,650		[1]800									
Wesco Refining Co.:												
Rangely	2,000		[2]200									
Total	35,650	9,700	9,250	12,500					450			1,500

INTERESTING FACTS ON VALVE PERFORMANCE

(from a case history in Crane's files)



12 years' steady service on hot oil . . . still dependable as ever

The location: Continental Oil Company's Ponca City refinery. The valves: Crane 300-pound steel gates. Their service record to date: 12 years of continuous, trouble-free performance on 675 deg. F. oil.

Installed on the thermofor catalytic cracking unit, these 6- and 8-inch Crane valves are in lines from the synthetic tower bottoms to the intermediate reflux heat exchangers. Since 1944, they have operated without interruption except during shutdowns for routine maintenance. They show no effects of this prolonged service, all valves giving tight closure with easy, non-sticking operation.

On each exchanger, the center control valve is used for throttling and is exposed to the erosive action of occasional catalyst fines. With minimum seat repairs, these Crane valves, too, continue giving service satisfaction.

On the job is where the difference between Crane quality steel valves and other makes shows best. It's mainly inside, in Crane Exelloy seating, for example—in its careful design . . . precise heat-treating . . . and accurate finishing.

That's how Crane assures you of dependable, durable, low-cost valve service for oil industry applications. And Crane puts such quality into steel valves for all your needs—gates, globes, angles, checks—in pressure classes up to 2500 psi—sizes up to 24 in.

Your local Crane Representative is a good man to work with when you're ready. Or write to address below.

CRANE VALVES & FITTINGS

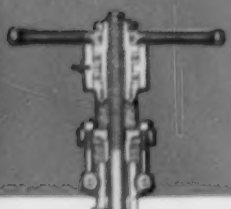
PIPE • KITCHENS • PLUMBING • HEATING

More Facts on Steel Valves—See Over

Since 1855—Crane Co., General Offices: Chicago 5, Ill. Branches and Wholesalers Serving All Areas

You're not getting this quality unless they're

CRANE STEEL VALVES

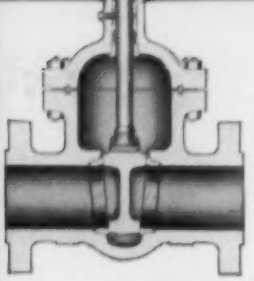


Don't ever make the mistake of taking steel valve quality for granted. Other makes may even look like Crane, but that's as far as the resemblance goes.

In Crane quality only do you get pioneering skill in casting steel valves with the high development of today's metallurgy techniques. Nor is there a substitute for the extra care Crane gives to machining, assembly and testing, with facilities that have no equal.

With 100 years' flow control engineering experience, Crane puts the finest features into a complete line of steel valves for petroleum refinery services.

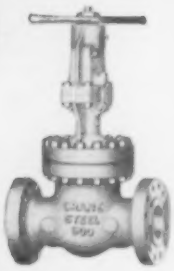
These valves are your best assurance of dependable, low-cost control of oil, oil vapor, steam, water, air, gas, etc., at all operating pressures and temperatures.



CRANE STEEL WEDGE GATE VALVES

Screwed, Flanged or Welding Ends
Sizes up to 24 in.
In 150, 300, 400, 600, 900, 1500, and 2500-Pound Pressure Classes

Cross-section shows 600-pound gate pattern. Note balanced ruggedness with features such as fully guided disc, non-rigid T-head disc-stem connection, shoulder type body seat rings, and straight-through flow.



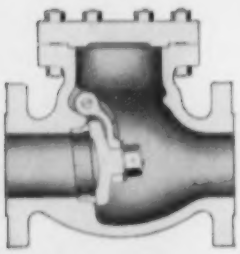
900-pound gate pattern, flanged ends

CRANE STEEL GLOBE AND ANGLE VALVES

With Plug-Type or Ball-Type Disc
Screwed, Flanged or Welding Ends
Sizes up to 8 in.
In 150, 300, 400, 600, 900, 1500, and 2500-Pound Pressure Classes

Cross-section shows 900-pound globe pattern with ball-type disc, recommended for oil services. Note the powerful stem and yoke for positive closure, the free-swivel disc-stem connection, the self-equalizing ball gland, and deep stuffing box among other features.

300-pound angle pattern, flanged ends



CRANE STEEL CHECK VALVES

Swing Type
Screwed, Flanged or Welding Ends
Sizes up to 12 in.
In 150, 300, 400, 600, 900, 1500, and 2500-Pound Pressure Classes

Cross-section shows 300-pound swing check, flanged ends. Note full-port area from inlet to valve seat to avoid turbulence, and generous body area to outlet, to minimize erosion and flow resistance. Screwed-in seat ring gives added tightness.

600-pound swing check valve, flanged ends

YOUR COMPLETE GUIDE TO STEEL VALVES

Your Crane Catalog leads you quickly to the best choice of valve for each need. It gives you plus information—all you need and more to answer any likely questions. You'll appreciate its comprehensive description of materials and design features . . . the complete dimensional data . . . and service recommendations. You get more in every way from your Crane Catalog and your local Crane Representative.

DELAWARE

Company and location	Charge, bbl. per stream day: Crude capacity	Vacuum dist.	Thermal operations	Cat cracking—Feed	Cat cracking—Per cent	Cat reforming	Hydrogenation	Production: Alkylation	Polymerization	Lubes (bbl.) coke (tons)	Asphalt
The Texas Co.:											
Claymont	*3,500	*1,750									*‡ 2 ‡1,500
Total:	3,885	1,943									1,665

*Barrels per calendar day. ‡State totals include calendar day figures converted to stream day.

FLORIDA

Seminole Asphalt & Refining, Ltd.:											
St. Marks	2,000										‡600
											‡500

GEORGIA

American Oil Co.:											
Savannah	7,000										‡3,500

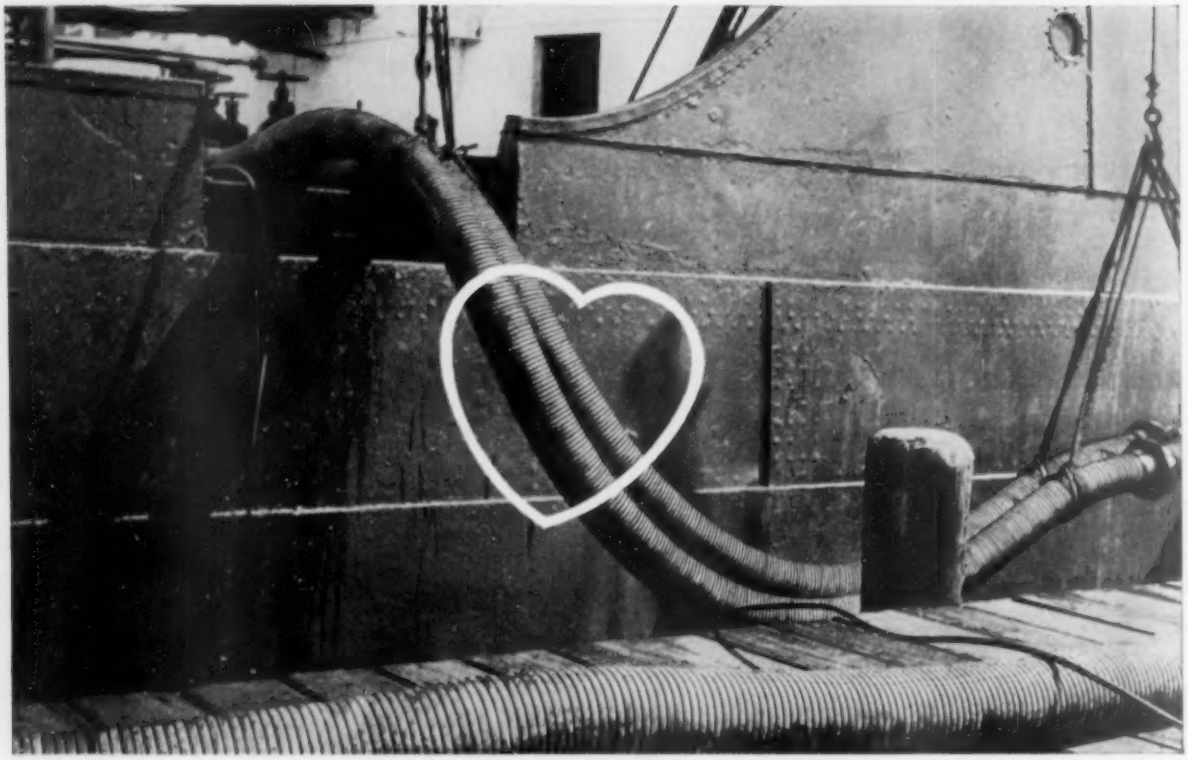
ILLINOIS

Advance Refining Co., Inc.:											
Centralia	2,500			‡650	0						
Calumet Refining Co.:											
Burham	1,200	1,200								‡750	
Clark Oil & Refining Corp.:											
Blue Island	20,000	4,000	‡2,000	‡7,500	13.3	‡6,000			‡600		‡1,000
Henry H. Cross Co.:											
Colmar	1,000										
Ohio Oil Co.:											
Robinson	40,000		‡9,000	‡27,500	33	‡8,000		‡1,500	‡1,500	‡250	
			‡6,000								
Pana Refining Co.:											
Pana	5,000		‡2,200			‡650			‡120		‡1,050
Pure Oil Co. (formerly Globe Oil & Refining Co.):											
Lemont	48,000		‡3,000	‡23,000	12			‡1,600	‡2,000		‡5,500
			‡6,000								
Shell Oil Co.:											
Wood River	170,000	68,000	‡15,500	‡55,000	35	‡16,000	‡11,000	‡9,000	‡1,200	‡3,100	‡3,500
			‡20,000							‡800	
			‡14,000								
Sinclair Refining Co.:											
Hartford	29,000	12,000	‡6,000	‡11,550	5				‡800		‡1,500
				‡6,000	0						‡500
Socony Mobil Oil Co., Inc.:											
East St. Louis	40,000		‡5,600	‡33,000	27			‡2,500	‡650	‡300	
			‡10,000								
Standard Oil Co. (Ind.):											
Wood River	53,500	6,000	‡10,200	‡19,000	4	‡9,000		‡3,400	‡123	‡1,073	‡2,500
			‡3,400							‡126	‡2,500
			‡7,060								‡1,800
			‡3,740								
The Texas Co.:											
Lawrenceville	*55,000	*15,000	*‡12,000	*‡30,000		*‡13,500	*‡13,500	*‡2,000	*‡2,500	*‡ 2	*‡2,200
Lockport	*65,000	*13,500	*‡15,000	*‡30,000		*‡10,000	*‡10,000	*‡4,400	*‡600	*‡250 *‡ 2	*‡3,000
			*‡9,500			*‡9,000					
Total:	543,400	122,835	164,215	249,800		75,725	37,085	25,104	10,434	‡4,923	25,622
										‡1,754	

‡Barrels per calendar day. ‡State totals include calendar day figures converted to stream day.

INDIANA

Berry Asphalt Co.:											
Gary	6,000										
Cities Service Oil Co.:											
East Chicago	53,000		‡15,000	‡31,500	25	‡13,000		‡2,560		‡440	
Indiana Farm Bureau Co-op. Association, Inc.:											
Mount Vernon	10,000	3,790	‡2,650	‡5,355	34				‡200		
Jarvis Refinery:											
Troy	1,500								‡692		
R. J. Oil & Refining Co., Inc.:											
Princeton	4,000		‡1,800			‡1,200					
Rock Island Refining Corp.:											
Rock Island	15,200	4,200	‡6,000	‡7,500	17.5	‡2,400	‡450		‡400		
Sinclair Refining Co.:											
East Chicago	111,000	47,000	‡12,000	‡45,000	25	‡18,000		‡650	‡2,450	‡2,750	‡4,000
			‡18,000								
Socony Mobil Oil Co., Inc.:											
East Chicago	38,000		‡7,500	‡18,000	15						
			‡3,200								
Standard Oil Co. (Ind.):											
Whiting	220,000	14,000	‡42,000	‡60,000	0	‡14,000	‡5,600	‡5,000	‡1,000	‡7,200	‡800
			‡14,000							‡930	‡7,210
			‡15,300								‡260
			^41,000								
Total	458,700	68,990	178,450	167,355		48,600	6,050	8,210	4,742	‡9,950	12,270
										‡1,370	



BLACK GOLD, BLACKSTRAP OR BLACK DIAMONDS ...PENFLEX MOVES IT, AFLOAT OR ASHORE

Whether cargo is a reasonably heavy liquid like crude oil . . . tacky like blackstrap molasses . . . semi-solid like asphalt . . . a granular solid like coal . . . it finds smooth passage through Penflex tubing. It can be non-combustible or highly volatile . . . Penflex leak-proof construction makes any transfer safe.

Being flexible, Penflex tubing "gives" . . . rides with the tide in ship unloading . . . simplifies transfer from railroad cars and tank trucks . . . enables stationary tanks to settle or "move" with temperature changes, without breaking their connecting transfer lines.

It's rugged too . . . outlasts by far any solid piping or other types of hose in moving abrasive solids like coal, sand or copra.

These combined features give Penflex numerous applications . . . as air intake or exhaust lines on Diesels and compressors, expansion joints on steam lines, piping for gases, water and all kinds of fuel and lube oils.

You'll get some ideas on applying Penflex from the booklet "FLEXINEERING," which shows some of the types available and typical uses. Write today for your copy.

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flexineering by

PENFLEX

HEART OF INDUSTRY'S LIFELINES

FLEXIBLE TUBING, AUTOMATIC BARREL FILLERS, PNEUMATIC RIVET PASSERS, ACCESSORIES AND FITTINGS

KANSAS

Company and location	Charge, bbl. per stream day: Crude capacity	Vacuum dist.	Thermal operations	Cat cracking: Feed	Cat cracking: Per cent	Cat reforming	Hydrogenation	Production: Alkylation	Polymerization	Lubes (bbl.) coke (tons)	Asphalt
Anderson-Prichard Oil Corp.: Arkansas City	17,500	5,500	[1]3,500	[1]11,000	45	[1]4,000			[2]600		[1]800
Century Refining Co., Inc.: Shallow Water	6,000		[1]1,500	[1]1,000	0				[2]50		[1]300
Chanute Refining Co.: Chanute			[2]1,500								
Cooperative Refinery Association: Coffeyville	25,000	6,500	[1]2,500	[1]9,750	20.5				[2]600	[1]1,500	[1]1,600
Phillipsburg	10,000	3,800		[1]8,000	50				[2]500		[1]1,500
Derby Oil Co.: Wichita	16,000	7,000	[1]3,000	[2]7,500	46.7				[2]750		[1]2,000 [2]200
El Dorado Refining Co.: El Dorado	16,000	5,000		[1]12,000	50				[2]1,200		[1]1,100 [2]300
Mid-America Refining Co. (formerly M. F. A. Oil Co.): Chanute	2,000		[1]1,200								
National Co-op Refinery Association: McPherson	28,500	11,000	[1]2,000 [4]11,000	[1]18,000	32				[2]1,000	[2]250	
Phillips Petroleum Co.: Kansas City	55,000	15,000		[1]40,000	40				[2]1,700	[1]2,000	[1]1,800
Skelly Oil Co.: El Dorado	45,000	12,000	[1]12,000 [5]5,000	[1]22,500	12	[1]7,500			[2]1,400		[1]3,000
Socony Mobil Oil Co., Inc.: Augusta	35,000	12,500	[1]4,500	[2]23,000	30	[1]3,000		[1]1,400			[1]5,750 [2]450 [3]800
Standard Oil Co. (Ind.): Neodesha	22,000		[1]1,600 [2]2,600 [7]5,100	[1]10,000	18			[1]1,000		[2]85	[2]500
Vickers Petroleum Co., Inc.: Potwin	14,500	8,000	[1][2]3,500 [3]1,200	[2]7,000	21				[2]550		
Total	292,500	86,300	62,000	169,750		14,500		2,400	8,350	[1]3,500 [2]335	20,300

KENTUCKY

Company and location	Crude capacity	Vacuum dist.	Thermal operations	Cat cracking: Feed	Cat cracking: Per cent	Cat reforming	Hydrogenation	Alkylation	Polymerization	Lubes (bbl.) coke (tons)	Asphalt
Ashland Oil & Refining Co.: Catlettsburg	55,000	21,000	[1]6,000 [2]2,500	[2]25,000	20	[2]6,000	[4]8,500		[2]2,400		[2]5,000 [3]1,000
Louisville Refining Co., Inc.: Louisville	7,000	3,500	[1]2,500	[1]3,800	21				[2]350		
Sohio Petroleum Co.: Covington	18,000	12,000	[1]7,000 [3]3,500						[2]500		[2]3,500
Somerset Refinery: Somerset	1,500					[1]400					
Total	81,500	36,500	21,500	28,800		6,400	8,500		3,250		9,500

LOUISIANA

Company and location	Crude capacity	Vacuum dist.	Thermal operations	Cat cracking: Feed	Cat cracking: Per cent	Cat reforming	Hydrogenation	Alkylation	Polymerization	Lubes (bbl.) coke (tons)	Asphalt
Atlas Processing Co.: Shreveport	[4]17,500		[2]2,500			[1]8,000			[2]500		
Bayou State Oil Corp.: Hosston	1,200	1,000								[1]500	[1]250
Bay Petroleum Corp.: Chalmette	20,000	8,400	[2]9,400	[1]11,250	33						
Breaux Bridge Oil & Refining Co., Inc.: Anse La Butte	1,600		[1]1,200								
Calumet Refining Co.: Princeton	900									[1]750	
Canal Refining Co.: Church Point	1,200					[7]900					
Cit-Con Oil Corp.: Lake Charles		26,000								[1]9,000	
Cities Service Refining Corp.: Lake Charles	180,000	26,000	[1]10,000 [7]12,000	[1]26,000	32	[2]18,000		[1]3,500			
Clark Oil & Refining Corp.: Marrero	6,500		[1]3,000						[2]125		
Continental Oil Co.: Westlake	51,100		[1]5,800 [2]2,600	[2]24,000	12.5	[1]5,600		[1]2,400	[1]660 [2]660		
Esso Standard Oil Co.: Baton Rouge	343,000	125,000	[1]36,500 [2]20,000 [3]9,000	[1]54,000	20	[2]27,800		[1]3,500	[2]6,500	[1]8,500	[1]9,800 [2]200
Evangeline Refining Co., Inc.: Jennings	2,000					[1][2]300					

LOUISIANA (Continued)

Company and location	Charge, bbl. per stream day: Crude capacity	Vacuum dist.	Thermal operations	Cat cracking: Feed	Cat cracking: Per cent	Cat reforming	Hydrogenation	Production: Alkylation	Polymerization	Lubes (bbl.)	Coke (tons)	Asphalt
Ingram Oil & Refining Co.:												
Meraux	10,000	4,200		[1]7,030	20							
Pan-Am Southern Corp.:												
Destrehan	35,000	5,000	[4]10,000	[1]18,000	0	[2]2,650		[1]2,500			[2]385	[1]940 [2]160 [3]500
Shell Oil Co.:												
Norco	82,000	39,000	[1]22,500 [2]2,000	[1]58,000	1.5			[1]4,200	[2]1,300			[1]1,800 [2]200 [3]300
Total	752,000	234,600	136,500	398,280		63,250		36,100	9,745	[1]18,750 [2]385		14,150

[4]Natural gasoline and cycle product charge, extracted for 650 bbl. per day benzene; remainder upgraded by thermal and cat reforming to motor fuel. [1]Alternate capacity.

MARYLAND

Company and location	Charge, bbl. per stream day: Crude capacity	Vacuum dist.	Thermal operations	Cat cracking: Feed	Cat cracking: Per cent	Cat reforming	Hydrogenation	Production: Alkylation	Polymerization	Lubes (bbl.)	Coke (tons)	Asphalt
American Bitumals & Asphalt Co.:												
Baltimore	7,500	7,500	*[2]6,000									[1]6,000 [2]400 [3]4,300
Esso Standard Oil Co.:												
Baltimore	62,000	26,000	[3]10,000	[1]60,500	35.6	[4]3,000	[2]17,000	[1]4,580		[2]350		[1]5,000 [2]2,000
American Oil Co.:												
Baltimore	10,000											[1]5,000
Total	79,500	33,500	10,000	60,500		3,000	17,000	4,580		[2]350		22,700

*Crude unit operated as visbreaker December, January, February, only for production of Bunker C fuel oil.

MASSACHUSETTS

Company and location	Charge, bbl. per stream day: Crude capacity	Vacuum dist.	Thermal operations	Cat cracking: Feed	Cat cracking: Per cent	Cat reforming	Hydrogenation	Production: Alkylation	Polymerization	Lubes (bbl.)	Coke (tons)	Asphalt
Esso Standard Oil Co.:												
Everett	55,000	13,500	[1]10,000 [2]5,000	24,500	40				[1]1,600			[1]7,500 *[2]2,500

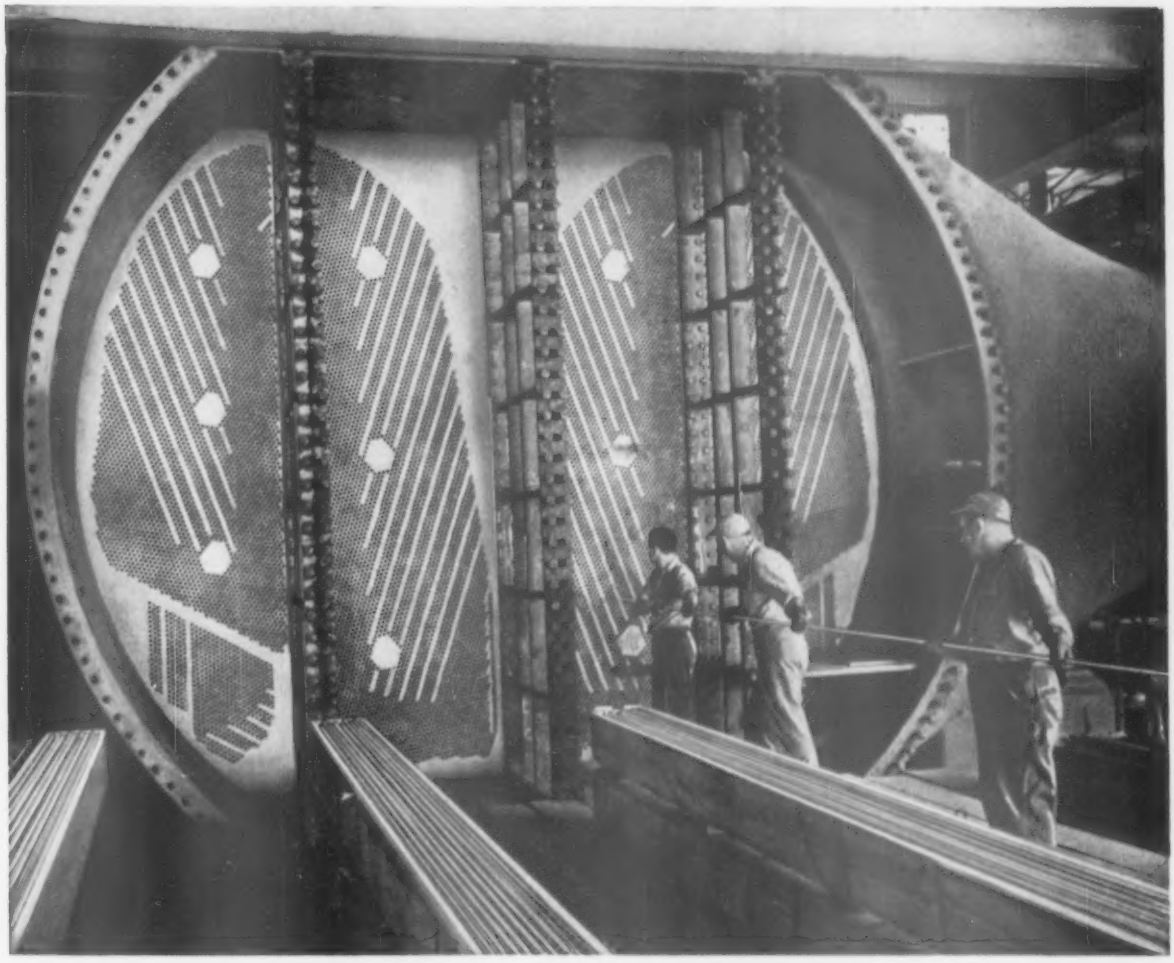
*Can oxidize additional 2,600 bbl. per stream day at expense of straightrun capacity.

MICHIGAN

Company and location	Charge, bbl. per stream day: Crude capacity	Vacuum dist.	Thermal operations	Cat cracking: Feed	Cat cracking: Per cent	Cat reforming	Hydrogenation	Production: Alkylation	Polymerization	Lubes (bbl.)	Coke (tons)	Asphalt
Aurora Gasoline Co.:												
Detroit	42,000	15,000	[2]7,500	[1]18,000	15	[1]7,000			[2]900			[1]5,000
Elsie	6,500					[1]1,500						
Muskegon	11,500		[2]3,400			[1]2,300	[1]500		[2]250			
Bay Refining Corp.:												
Bay City	9,000	2,000		[2]6,000	45				[2]300			
Crystal Ref. Co. of Carson City, Inc.:												
Carson City	6,200											
Lakeside Refining Co.:												
Kalamazoo	3,000		[1]1,000 [2]750									
Leonard Refineries, Inc.:												
Leonard Div., Alma	10,500	6,500		[2]7,500	10	[4]2,400	[2]5,200		[2]120			[1]1,500 [2]300
Mid-West Div., Alma	10,000		3,500			2,300			[2]140			
Roosevelt Div., Mount Pleasant	7,500			[2]3,000	6	[1]1,800						
Marvel Refining Co.:												
Grand Rapids	2,000											
Naph-Sol Refining Co.:												
Muskegon	6,000		[2]2,250			[1]1,200						
Osceola Refining Co.:												
Reed City	2,500											
Petroleum Specialties, Inc.:												
Flat Rock	6,000					[1]960						
Socony Mobil Oil Co., Inc.:												
Trenton	30,000		[2]4,700 *6,000	[2]23,000	28				[2]900	[2]190		
West Branch Refineries, Inc.:												
West Branch	3,500											[1]750
Total	156,200	23,500	29,100	57,500		19,400	6,700		2,620	[2]190		8,050

MINNESOTA

Company and location	Charge, bbl. per stream day: Crude capacity	Vacuum dist.	Thermal operations	Cat cracking: Feed	Cat cracking: Per cent	Cat reforming	Hydrogenation	Production: Alkylation	Polymerization	Lubes (bbl.)	Coke (tons)	Asphalt
Great Northern Oil Co.:												
Pine Bend	25,000		*10,000	[2]24,000	50	[4]5,000	[4]11,000		[2]900	[2]450		
International Refineries, Inc.:												
Wrenshall	12,000			[1]5,000	35				[2]270			
Northwestern Refining Co.:												
New Brighton	3,000	1,000										
St. Paul Park	14,000	8,000		[1]10,000	50				[2]650			
Total	54,000	9,000	10,000	39,000		5,000	11,000		2,020	[2]450		



IN FOR A BIG HEAT-TRANSFER JOB

...AND MANY YEARS OF SERVICE FROM

CHASE® ANTIMONIAL ADMIRALTY TUBE!

Remove 988 Btu's per pound of steam! Condense 1,046,830 pounds of steam per hour! Cool with raw lake water! That's the job of a single-pass condenser for a Great Lakes power and light company.

Tube dezincification is as much a problem in *this* heat-exchanger unit as it is in petroleum refineries. But Chase Antimonial Admiralty was selected for the tubes in this installation with many years of trouble-free service anticipated.

You see, Chase Antimonial Admiralty condenser and heat exchanger tubes have *virtually eliminated* tube failures caused by dezincification. Perfect alloying and tempering provide freedom from season cracking and permit easy rolling into tube sheets. And rigid quality controls at the mill assure tube as flawless as science can make it!

Insist on Chase Antimonial Admiralty!

CHASE WAREHOUSE STOCKS: Beaumont,* Houston,* Los Angeles, New Orleans, Tulsa**

*Handled by Standard Brass & Mfg. Co. **Handled by Vinson Supply Co.

Chase®

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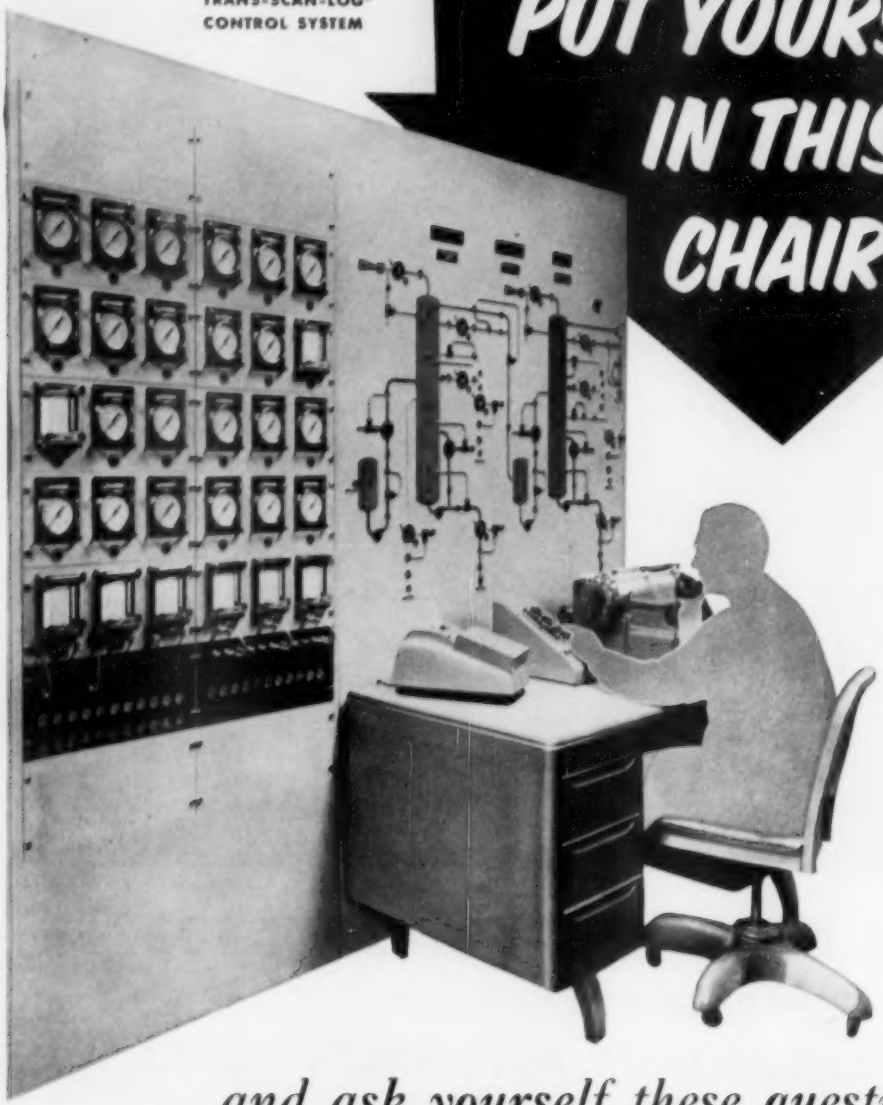
TAYLOR
TRANS-SCAN-LOG*
CONTROL SYSTEM

PUT YOURSELF IN THIS CHAIR



. . . and ask yourself these questions

Is scanning and logging, as I understand it, economically justified?

Perhaps not, if you're thinking just of mechanical logging of all variables, which gives little more than an accurate historical record of what has happened. But the new Taylor TRANS-SCAN-LOG System makes the operator more than a score-keeper. It enables him to instantly *visualize, evaluate* and *act upon* every processing irregularity as it occurs — without leaving his desk in front of the panel.

What effect would the TRANS-SCAN-LOG System have on my control room space and operator requirements?

It will take approximately 60% of the space normally required by a standard graphic panel *without* scanning and logging. The compactness of this "intelligence center" enables operator to supervise a greater percentage of the process. Because the scanning and logging equipment is an integral part of the process control, one operator can identify and correct any off-normal condition, as well as having a continuous trend record.

Where can I see this unit in operation?

We cordially invite you to come to Rochester to see this complete data collecting system in operation, because we believe that its many unique features *do* make it economically justified.

Your Taylor Field Engineer will be glad to make the necessary arrangements. In the meantime, write for **Bulletin 98268.** Taylor Instrument Companies, Rochester, N.Y., or Toronto, Canada.

*Trade Mark

Taylor Instruments
MEAN ACCURACY FIRST

MISSISSIPPI

Company and location	Charge, bbl. per stream day: Crude capacity	Vacuum dist.	Thermal operations	Cat cracking—Feed	Cat cracking—Per cent	Cat re-forming	Hydro-genation	Production: Alkylation	Poly-merization	Lubes (bbl.)	Coke (tons)	Asphalt
Paluxy Asphalt Co.:												
Yazoo City	5,600	2,000	†2,000						†150			†500
Southland Co.:												†500
Sandersville	5,500	3,100										†2,600
Total	11,100	5,100	2,000						†150			3,600

MISSOURI

Standard Oil Co. (Ind.):												
Sugar Creek	76,000	7,200	†19,600	†32,000	0	*†4,000			*†1,800	*†505		†2,000
			*†6,000									†1,000
			†5,500									†1,000
			*†4,900									

*If this capacity is used, thermal cracking capacity is reduced by 6,000.

MONTANA

Big West Oil Co. of Montana:												
Kevin	2,500		†1,250									
Carter Oil Co.:												
Billings	23,000	8,000	†3,800	†25,000	50	†*2,500	†6,900		†600	†210		†4,000
Continental Oil Co.:												
Billings	10,000			†10,500	54				†450			
Farmers Union Central Exch., Inc.:												
Laurel	17,000	9,000	†5,500	†11,000	1.4				†1,700			†3,800
												†900
Eugene Hunt:												
Winnett	300											
Jet Fuel Refinery:												
Mosby	600											
Modern Oil Co., Inc.:												
Shelby	1,000											
Phillips Petroleum Co.:												
Great Falls	2,500	1,600	†1,200						†30			†400
The Texas Co.:												
Sunburst	*8,000		*†5,000						*†100			
Union Oil Co. of California:												
Cut Bank	3,900		†400			†600	900		†75			
			†2,300									
Unity Petroleum Corp.:												
Kalispell	1,000											†600
Total†	70,680	18,600	20,000	46,500		3,100	7,800		2,966	†210		9,700

*Barrels per calendar day. †State totals include calendar day figures converted to stream day.

NEBRASKA

Cooperative Refinery Association:												
Scottsbluff	2,200		†1,000			650						
Searle Petroleum Co.:												
Salem	1,000											
Total	3,200		1,000			650						

NEW JERSEY

California Oil Co.:												
Perth Amboy	72,000		†5,000	†28,000	20	†10,000		†2,100	†300			†5,500
Cities Service Oil Co.:												
Linden	15,000											†3,300
												†2,900
												†1,300
Esso Standard Oil Co.:												
Bayonne	26,500	15,000								†500		†8,200
Linden	172,700	73,800	†12,000	†98,000	26		†30,000		†6,700			†2,000
			†15,000									
			‡†8,500									
Socony Mobil Oil Co., Inc.:												
Paulsboro	100,000	43,000	†6,000	†35,000	25			†2,300		†8,000		†1,200
The Texas Co.:												
Westville	*60,000	*22,000	*†9,000	*†35,000		*†12,000		*†1,600	*†2,500			
Total†	452,800	156,220	47,990	199,850		23,320	30,000	6,176	9,775	†8,500		24,400

*Barrels per calendar day. †State totals include calendar day figures converted to stream day. ‡Oil cracking capacity available only at expense of 6,500 bbl. per stream day reforming capacity reported above.

How Men of Science help you sell!

Every year, your customers drive in with more powerful engines in their cars. Engines that *demand* super fuels.

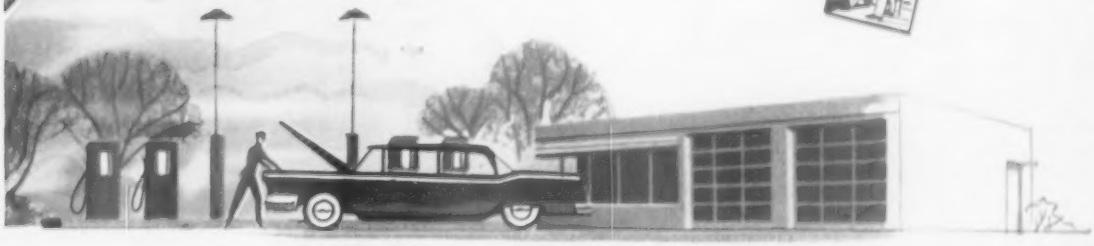
To develop these super fuels (and keep pace with engine design) thousands of skilled scientists and researchers are constantly at work throughout the petroleum industry.

Outstanding among these men of science are the research and engineering staffs of Universal Oil Products Company. Working closely with refiners of every size, UOP concentrates on the development of fundamental refining processes that will produce better motor fuels economically to the benefit of the entire petroleum industry and the millions of motorists throughout the country.

Result: You are continually able to offer your customers the finest products from petroleum, at the lowest possible cost.

Yes, you can count on Men of Science to help you make your selling job easier.

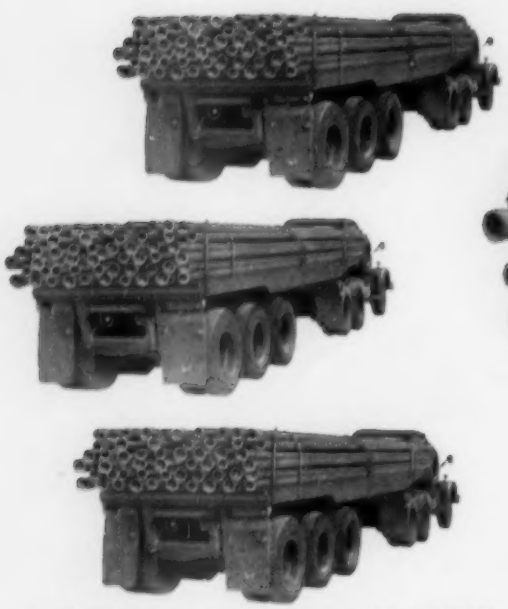
UOP has prepared an interesting booklet on "How Men of Science Help You Sell". We'll be glad to send you a copy on request.



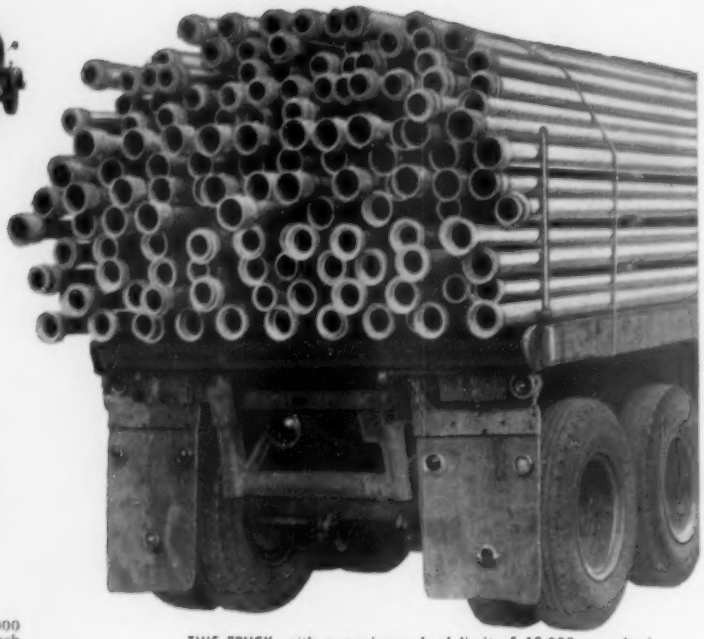
UNIVERSAL OIL PRODUCTS COMPANY

30 ALGONQUIN ROAD, DES PLAINES, ILLINOIS, U. S. A.

Forty years of Leadership in Petroleum Refining Technology



THESE THREE TRUCKS, each with a maximum load limit of 18,000 pounds, are loaded to capacity with 55 lengths of 30-foot, 4-inch steel pipe. Total weight of the steel pipe is over 53,500 pounds—barely within load limits! Total pipe footage—only 4,950 feet, substantially less than a mile!



THIS TRUCK, with a maximum load limit of 18,000 pounds, is loaded with 176 lengths of 30-foot, 4-inch Kaiser Aluminum pipe! Total weight of the pipe is about 5,500 pounds—well within the load limit! Total pipe footage—one full mile!

ONE TRUCK CARRIES A FULL MILE OF LIGHTWEIGHT KAISER ALUMINUM PIPE!

As YOU can see from the pictures on this page, load limit based on weight is *not a factor* with lightweight Kaiser Aluminum petroleum pipe.

At least three trucks are required to haul a mile of commonly used steel pipe. But this same footage can be hauled *easily with only one truck* when you use Kaiser Aluminum pipe!

With Kaiser Aluminum pipe you cut the cost of hauling by two-thirds!

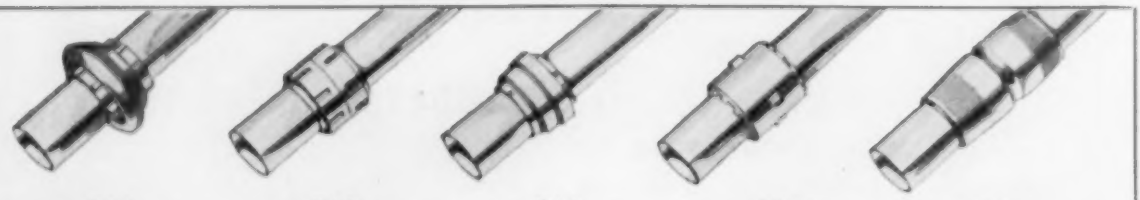
And this is only *part* of the savings you get when you use the Kaiser Aluminum pipe and coupler system for your supply lines. Newly developed detachable couplers speed connecting and disconnecting time to give you additional savings of $135.48 per mile! And the light weight of Kaiser Aluminum pipe permits extremely fast handling, resulting in savings up to $84.35 per mile on loading, stringing and pickup!

Your nearby supplier stocks Kaiser Aluminum petroleum pipe in 30-foot lengths of 2, 3 and 4 inch diameters, with cladded inside surfaces for added corrosion resistance. He also has couplers and fittings to complete your system.

For further information, contact the Kaiser Aluminum sales office listed in your telephone directory or any of the fitting manufacturers listed below. Kaiser Aluminum & Chemical Sales, Inc., *General Sales Office*, Palmolive Bldg., Chicago 11, Ill.; *Executive Office*, Kaiser Bldg., Oakland 12, California.

Kaiser Aluminum

setting the pace—in growth, quality and service



Made by
Food Machinery & Chemical Corp.
John Bean Division
San Jose, California.

Made by
Gateway Engineering Co.
3233 W. Grand Avenue
Chicago 51, Ill.

Made by
Industrial Coupler Co.
P.O. Box 1751, 4218 Boone Ave.
Spokane, Wash.

Made by
Warren Manufacturing Co.
11 Hamburg Turnpike
Riverdale, N. J.

Made by
Wright Engineering & Supply Co.
1300 S. Bannock St.
Denver 23, Colo.

THESE FIVE tested and approved fittings require no welding: field tie-in to existing systems may be accomplished quickly and easily. Couplers assure leakproof connections at liquid and gas pressures of 0 to 1000 psi.

NEW MEXICO

Company and location—	Charge, bbl. per stream day: Crude capacity	Vacuum dist.	Thermal operations	Cat cracking— Feed	Cat cracking— Per cent	Cat re-forming	Hydro-genation	Production: Alkylation	Polymerization	Lubes (bbl.)	Asphalt (tons)
Continental Oil Co.:											
Artesia	4,300	1,875									
Farmington	800										
El Paso Natural Gas Products Co.:											
(Was Malco Products, Inc.) at Bloomfield	500										
(Was McNutt Oil & Ref. Co.) at Brickland	4,000		†1,500			600			†40		
(Was Malco Refineries, Inc.) at Prewitt	3,000		†1,000			†750			†40		
Famariss Oil & Refining Co.:											
Monument	2,200					†700	†1,000				
Malco Asphalt & Refining Co.:											
(Was New Mexico Asphalt & Ref. Co.) at Artesia	10,000	5,000		†3,400	23				†300		†1,400
Total	24,800	6,875	2,500	3,400		2,050	1,000		380		1,400

NEW YORK

Ashland Oil & Refining Co.:											
North Tonawanda	27,000	12,000	†2,700	†17,000	35				†900		†3,000
Gulf Oil Corp.:											
Staten Island	*17,000										
Sinclair Refining Co.:											
Wellsville	8,000	3,000	†3,000 †5,000						†100	†2,500	†300
Socony Mobil Oil Co., Inc.:											
Brooklyn	26,000			†23,000	48				†1,200		
Buffalo	26,000	6,000	†4,000	†18,000	30				†1,000	†1,050	†300 †2,000
Total†	165,870	21,000	14,700	58,000					3,200	†3,550	5,600

*Barrels per calendar day. †State totals include calendar day figures converted to stream day.

NORTH DAKOTA

Queen City Oil & Refining Co.:											
Dickinson	1,500		†750								
Standard Oil Co. (Ind.):											
Mandan	33,000			†23,000	48				†4,365		
Westland Oil Co. (was Williston Basin Refining Corp.):											
Williston	1,500					†300					
Total	36,000		750	23,000		300			4,365		

OHIO

American Bitumuls & Asphalt Co.:											
Cincinnati	10,000	10,000									†7,500 †4,000
Ashland Oil & Refining Co.:											
Canton	27,500		†11,000	†15,000	24				†1,200		
Findlay	16,000	8,000	†5,500 †1,500						†250	†1,000	†1,600
Dewese Oil Refinery:											
Weston	1,500										
Gulf Refining Co.:											
Cleves	*32,000	*7,500	*†9,800	*†12,000		*†10,000			*†1,500		
Toledo	*40,000	*6,200	*†10,700 *†1,500	*†12,200		*†10,000			*†1,500		
Pure Oil Co.:											
Newark	17,500	6,100	†6,400	†4,500	0	†3,000	†3,000		†450		
Toledo	39,400	4,400	† †6,500 †5,000	†11,600	35.5	†5,000			†1,270	†175	
Standard Oil Co. (Ohio):											
Cleveland	55,000	18,000	†12,000 †10,000	†28,000	25				†1,000	†1,600	†7,000
Lima	50,000	11,000	†11,000	†35,000	15	†12,000	†13,000		†800	†1,700 †320	
Toledo	28,000		†8,000 †7,000 †7,000					†5,900	†700	†180	
Sun Oil Co.:											
Toledo	*86,000		*†17,000	*†58,000		*†14,700					
Total†	420,280	72,707	134,190	185,342		58,517	16,000	5,900	9,000	†4,300 †675	20,100

*Barrels per calendar day. †State totals include calendar day figures converted to stream day.

OKLAHOMA

Allied Materials Corp.:											
Stroud	3,000	1,500									†1,500 †1,500
Anderson-Prichard Oil Corp.:											
Cyril	11,000	5,000	†5,000			†1,000			†250		†1,200 †500

OKLAHOMA (Continued)

Company and location	Crude capacity	Charge, bbl. per stream day: Vacuum dist.	Thermal operations	Cat cracking—Feed	Cat cracking—Per cent	Cat reforming	Hydrogenation	Production: Alkylation	Polymerization	Lubes (bbl.)	Coke (tons)	Asphalt
Bell Oil & Gas Co.:												
Grandfield	8,000		[1]4,000			[1]1,600			[2]50			
Ben Franklin Refining Co.:												
Ardmore	12,000	5,000	[1]2,000	[1]6,000	45				[2]550			[1]2,000
Champlin Refining Co.:												
Enid	23,000	9,000	[2]5,000 [3]4,000	[1]13,500	33.3	[1]5,000			[2]950	[1]1,300		
Cities Service Oil Co.:												
Ponca City	23,500	7,000	[1]800 [2]2,200 [7]1,950	[1]14,000	28					[2]100		
Continental Oil Co.:												
Ponca City	58,000	10,800	[1]6,500 [3]4,000 [6]12,500	[2]33,500	43	[1]5,000		[2]5,000	[2]700	[1]2,100 [2]400		
Deep Rock Oil Co.:												
Cushing	19,000	3,400	[2]6,700	[1]10,000	30				[2]500	[1]1,000		[1]500
Wynnewood	17,000	6,000	[2]1,500	[1]9,000	33				[2]550			[1]3,000 [2]1,000
D-X Sunray Oil Co.:												
Duncan	37,000	13,000	[1]9,000	[1]25,500	16	[1]6,000		[1]3,000	[2]550	[1]400		
West Tulsa	67,500	19,600	[1]9,600	[1]32,400	17	[7]7,500		[1]2,740	[2]1,850	[1]5,560 [2]310		[1]1,078
Johnson Oil Refining Co.:												
Cleveland	6,500		[1]3,300			[1]1,840			[2]250			
Mercury Oil Refining Co.:												
Oklahoma City	5,000		[1]1,400									
Midland Cooperatives, Inc.:												
Cushing	13,000		[2]6,000	[1]8,500	44				[2]950			
Monarch Refineries, Inc.:												
Oklahoma City	1,000											[1][2]1,000
Phillips Petroleum Co.:												
Okmulgee	17,500	8,000		[1]10,000	30				[2]700			
The Texas Co.:												
West Tulsa	*35,000	*9,000	*[1]9,000 *[2]5,000	*[1]15,000		*[1]8,000	*[1]8,000		*[1]1,500			
Wilcox Oil Co.:												
Bristow	5,300		[1]2,250			[1]1,700			[2]120			
Total[1]	366,150	98,200	103,240	179,050		38,520	8,880	10,740	9,635	[1]9,960 [2]1,210		13,278

*Barrels per calendar day. [1]State totals include calendar day figures converted to stream days. [2]Will be closed spring of 1956.

OREGON

Company and location	Crude capacity	Charge, bbl. per stream day: Vacuum dist.	Thermal operations	Cat cracking—Feed	Cat cracking—Per cent	Cat reforming	Hydrogenation	Production: Alkylation	Polymerization	Lubes (bbl.)	Coke (tons)	Asphalt
American Bitumuls & Asphalt Co.:												
Portland	6,500	6,500										[1]4,200 [2]900 [3]1,150

PENNSYLVANIA

Company and location	Crude capacity	Charge, bbl. per stream day: Vacuum dist.	Thermal operations	Cat cracking—Feed	Cat cracking—Per cent	Cat reforming	Hydrogenation	Production: Alkylation	Polymerization	Lubes (bbl.)	Coke (tons)	Asphalt
Ashland Oil & Refining Co.:												
Freedom	6,000	2,100									[1]1,250	
Atlantic Refining Co.:												
Philadelphia	*148,000	*40,000		*[1]59,000	40	*[1]12,000		*[1]5,000	*[2]1,900	*[1]5,000		*[1]6,000 *[2]800 *[3]1,500
Gulf Oil Corp.:												
Philadelphia	*183,000	*70,000	*[1]11,200	*[1]85,000		*[1]16,000		*[1]2,800	*[2]3,600	*[1]1,000		
Kendall Refining Co.:												
Bradford	5,000		[7]1,500			[1]1,500			[2]100	[1]1,206 [2]25		
Pennsylvania Refining Co.:												
Karns City	1,500	600								[1]400		
Pennzoil Co.:												
Rouseville	10,000	3,500	[1]1,600	[1]3,600	11	[1]2,900	[1]3,650		[1]960	[1]2,500		
Quaker State Oil Refining Corp.:												
Emlenton	3,000	1,500	[1]750 [2]600			[1]1,000			[2]75	[1]1,700		
Farmers Valley	4,500		[1]1,350			[1]1,500			[2]100	[1]2,300		
Sinclair Refining Co.:												
Marcus Hook	102,000	45,000	[1]5,000 [2]27,000	[1]45,000	25	[1]16,000	*[1]10,000		[2]1,850			
Sonneborn, L., Sons, Inc.:												
Franklin	2,000									[1]500		
Sun Oil Co.:												
Marcus Hook	*145,000		*[1]24,000	*[2]20,000 *[3]26,000 *[4]28,500		*[1]32,000				*[1]11,800		*[1]800
United Refining Co.:												
Warren	8,500	4,500	[1]1,800 [2]2,000			[1]2,600	[1]750			[1]1,000		[1]500
Wolf's Head Oil Refining Co., Inc.:												
Reno	2,500			[1]920						[1]750		
Total[1]	673,360	179,300	80,672	292,055		92,100	14,400	8,658	9,190	[1]31,358 [2]25		10,901

*Barrels per calendar day. [1]State totals include calendar day figures converted to stream day.

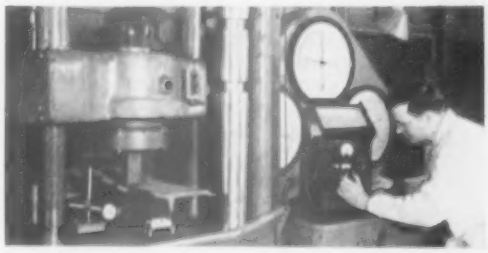
Biggest reason for using only Caterpillar original parts in your machine is a reason you cannot see or feel. It is the *ancestry* of Caterpillar parts.

Behind each and every CAT* replacement part is the experienced engineering, painstaking research, grueling testing, skilled manufacturing and rigid inspecting which make Caterpillar products the standard of the industry. With these truly "pedigreed" parts you can be sure of better all-around performance, less down time.

With substitute parts, can you be sure of anything?

See your dealer's Parts Representative — get Caterpillar original parts every time.

Caterpillar Tractor Co., Peoria, Illinois, U. S. A.



Special gauge measures exact amount of strain a track shoe part can endure. Constant testing like this guarantees that all parts are made to the highest Caterpillar standards. Why be satisfied with anything less?

CATERPILLAR*

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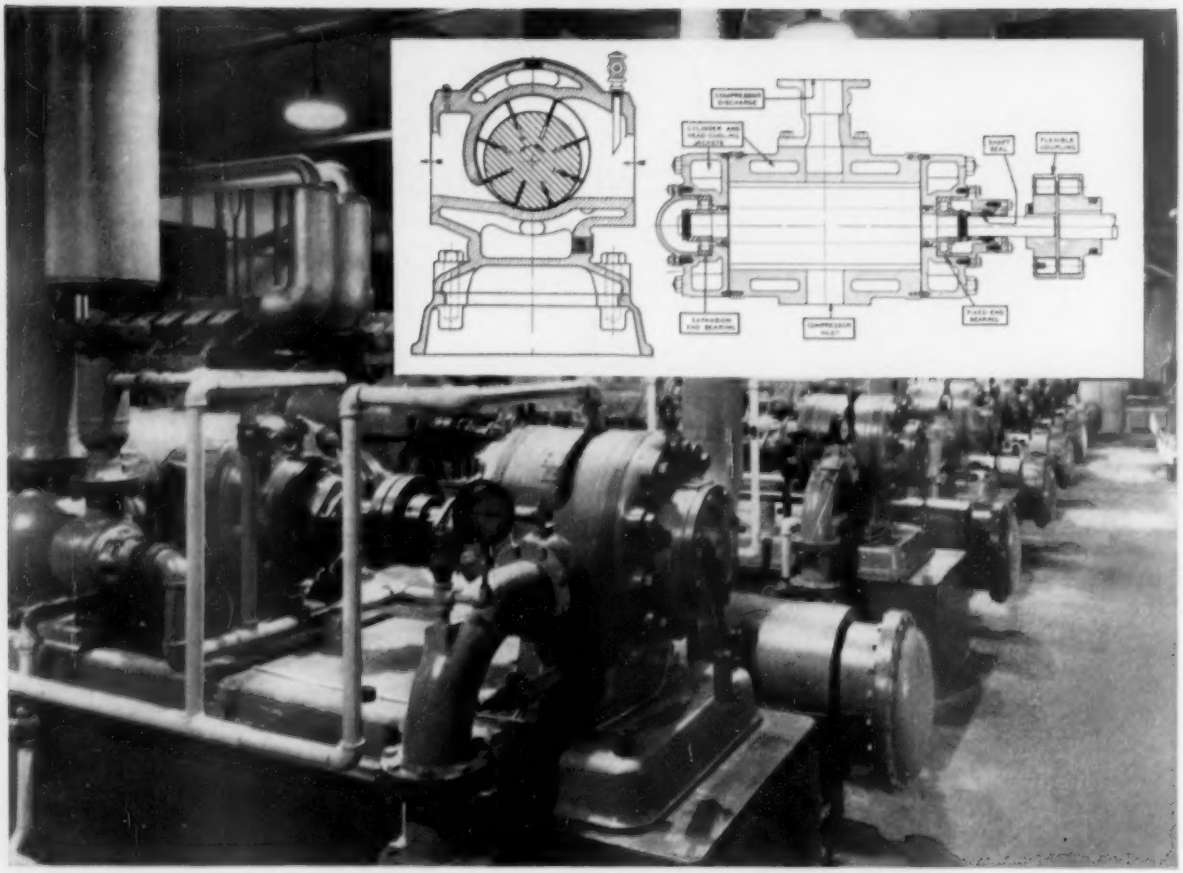

HERE ARE 7 FULLER ROTARY COMPRESSORS

. . . in *any* quantity they are an investment in dependability

The wide and continuing acceptance of the Fuller Rotary Compressor in the petroleum industry is based on a number of unique design features, eminently suited for gas gathering and boosting in any rugged situation. Indoors or out, its trouble-free operation makes for minimum maintenance and operating costs.

There are 8 good reasons why the Fuller Rotary Compressor enjoys such widespread use—they may easily serve as reasons why your next compressors should be Fuller Rotaries.

1. SIMPLICITY—Elimination of compressor valves, crankshafts, pistons and other moving parts greatly reduces the need for attention, adjustment and replacement. 2. PULSATION-FREE FLOW—Rotary compression eliminates pressure fluctuations and simplifies metering problems. 3. SUSTAINED PERFORMANCE—Blades are held out by centrifugal force, automatically compensating for wear, thus maintaining new-machine efficiency and capacity. 4. NON-VIBRATING—Rotary principle permits a design completely free of reciprocating parts, avoiding basic cause of vibration.

5. COMPACTNESS—Large capacity in relation to size results in lighter weight, compact, transportable units. 6. EASE OF INSTALLATION—In smaller sizes, no foundation is needed. Larger units need only concrete slab for foundation. Automatic safety controls are incorporated in package. 7. ECONOMY—Few moving parts of the compressor, and their accessibility, reduce maintenance to the minimum. 8. VERSATILITY—Unit can be operated at various conditions. Capacity variation of 50% can be obtained by change of speed with engine, turbine, or two-speed motor drives.

We'd like to send you fully-descriptive Fuller Compressor literature. It's yours for the asking.

FULLER COMPANY
132 Bridge St., Catasauqua, Pa.
A SUBSIDIARY OF GENERAL AMERICAN TRANSPORTATION CORP.
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C-287
2024

PIONEERS OF HIGH-EFFICIENCY VANE TYPE ROTARY COMPRESSORS SINCE 1930

RHODE ISLAND

Company and location	Charge, bbl. per stream day: Crude capacity	Vacuum dist.	Thermal operations	Cat cracking: Feed	Cat cracking: Per cent	Cat re-forming	Hydro-genation	Production: Alkylation	Production: Polymerization	Production: Lubes (bbl.)	Production: coke (tons)	Production: Asphalt
Socony Mobil Oil Co., Inc.:												
East Providence												[1]500 [2]6,000
The Texas Co.:												
Providence	*3,500	*1,750									*[1] [2]	[1]1,500
Total[†]	3,885	1,943										8,165

*Barrels per calendar day. [†]State totals include calendar day figures converted to stream day.

SOUTH CAROLINA

Esso Standard Oil Co.:												
Charleston	8,700	6,800										[1]4,100 [2]400

TENNESSEE

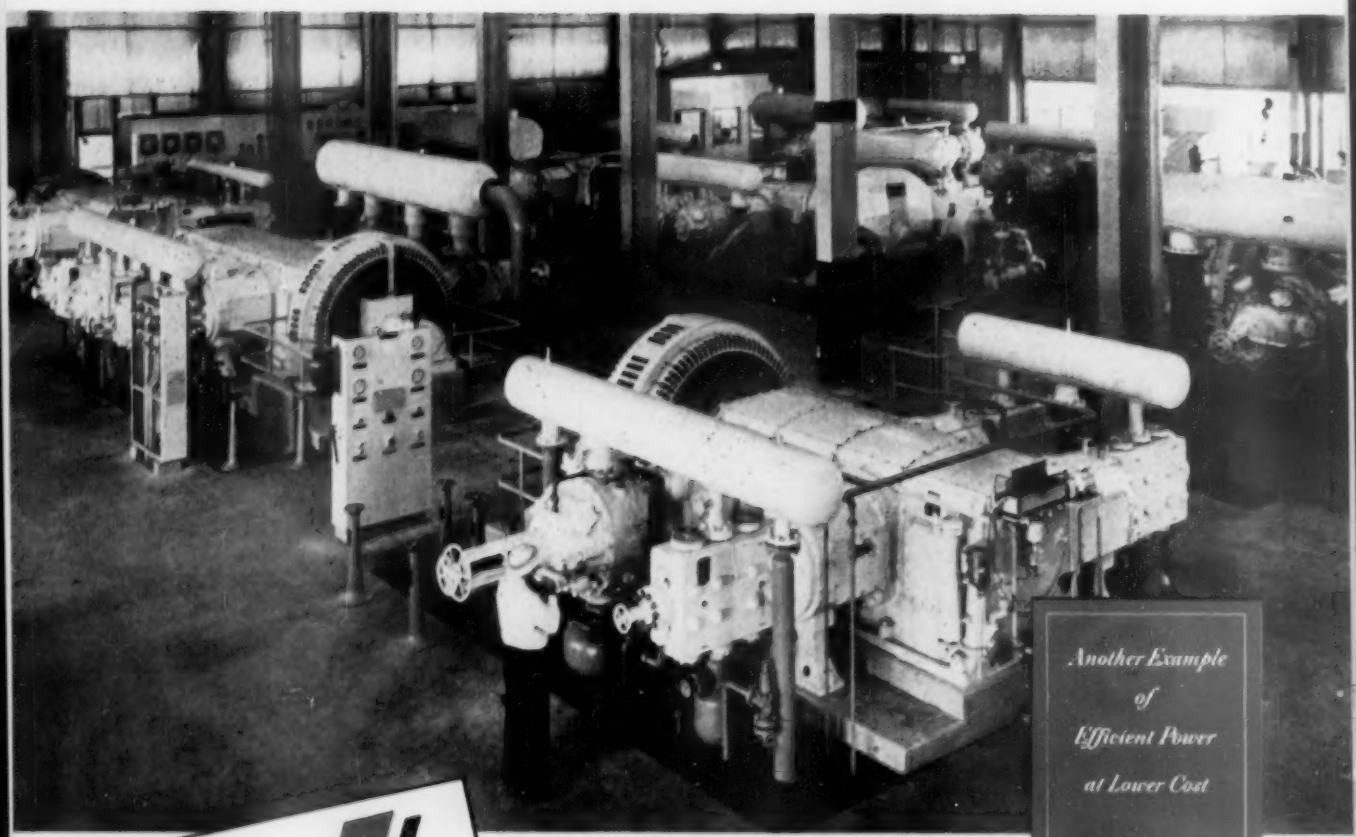
Delta Refining Co.:												
Memphis	6,000	1,000		[2]3,100	17.5				[1]250			
Southern Oil Service:												
Nashville	1,000											
Total	7,000	1,000		3,100					250			

TEXAS

American Liberty Oil Co.:												
Mount Pleasant	16,000	9,500	[2]2,000	[2]9,000	40				[1]400			[1]5,450 [2]550
American Oil Co.:												
Texas City	160,000	27,000	[1]28,000 [2]25,500 [3]10,500	[1]68,000	2	[2]21,000	[4]18,000	[1]9,000	[3]3,000			[1]5,000
Atlantic Refining Co.:												
Port Arthur	*61,000	*18,000		*[1]29,000	30	*[7]7,200			*[3]150			
Bryson Pipeline & Refining Co.:												
Bryson	2,000										250	
Col-Tex Refining Co.:												
Colorado City	12,000	6,000	[1]4,000			[1]1,500	[1]10		[1]80			[1]1,500 [2]500
Continental Oil Co.:												
Wichita Falls	9,000		[1]3,900 [3]1,350						[1]550 [3]200			
Corpus Christi Refining Co.:												
Corpus Christi	8,500	2,000										
Palestine	3,500								[1]150			
Cosden Petroleum Corp.:												
Big Spring	28,500	14,500	[1]7,500	[1]12,000	8	[4]4,500	[2]2,100	[2]3,000				[1]3,300 [2]350 [3]1,000
Crown Central Petroleum Corp.:												
Pasadena	32,000		[1]8,500 [2]1,000	[2]15,000	33.3	[1]5,000	[2]5,000	[2]3,300	[2]900			
Dallawax Co.:												
Kilgore	[1]500											
Danaho Refining Co.:												
Pettus	4,500		[1]1,000			[1]1,000			[2]50			
Delhi-Taylor Oil Corp.:												
Corpus Christi	40,000		[2]1,800	[2]10,500	9.5	[1]5,000			[2]480			
Delhi-Taylor Oil Corp. and Mayfair Minerals, Inc.:												
Port Isabel	10,500					[1]4,000						
Eastern States Petroleum Co., Inc.:												
Houston (2 plants)	55,000	25,000	[2]22,000	[1]16,000	9	[1]5,800	[1]15,000	[1]3,700	[2]1,000			
Eddy Refining Co.:												
Houston	2,200											
Flint Chemical Co.:												
San Antonio	230											
G & B Co.:												
Graham	700											
Gladewater Refining Co.:												
Gladewater	2,500		[1]1,500			[7]700			[1]100			
Gulf Oil Corp.:												
Port Arthur	*245,000	*65,000	*[1]66,200 *[3]18,000	*[1]54,000 *[2]25,000		*[1]29,000		*[1]4,000	*[2]3,600	*[1]12,000		
Humble Oil & Refining Co.:												
Baytown	313,100	(‡)	[1]22,000 [3]19,500	[1]107,800	10	[4]40,000	[2]54,700	[1]9,400	[1]3,700 [3]4,600	[1]15,800		[1]2,900
Magnolia Petroleum Co.:												
Beaumont	205,000	49,000	[2]60,000 [3]16,000	[2]78,400 *[1]1,800	9 1	[2]19,000		[1]7,000	[1]1,100	[1]7,100		
Matagorda Corp.:												
Bay City	1,850											
McBride Refining Co., Inc.:												
Brownsville	7,500	5,000										[1]3,500
La Blanca	3,500					[7]1,000						
McMurrey Refining Co.:												
Tyler	22,500		[1]4,500 [2]10,000	[1]10,000	15	[1]5,500		[1]2,200	[2]700	[2]100		
Monarch Refining Co.:												
San Antonio	2,500											

HERE'S MULTIPLE-SERVICE IN MODERN

with Cooper-Bessemer



Another Example of Efficient Power at Lower Cost

This over-all plant view shows several of the compact Cooper-Bessemer M-Line compressor units that deliver dependable performance in the Brea Chemicals, Inc. modern ammonia plant near Los Angeles.

ANGLE

Compressors

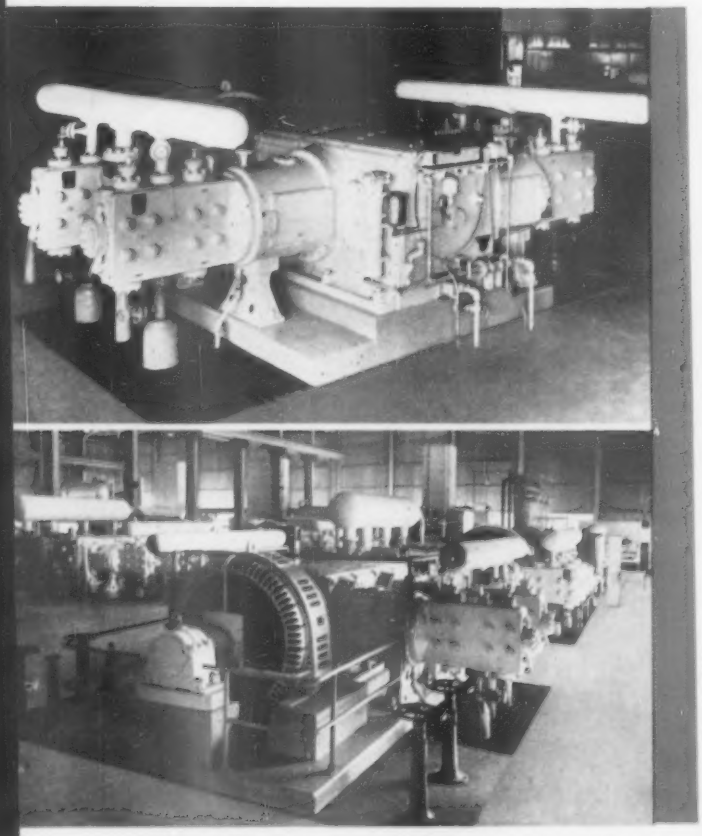
New York Washington, D. C. Bradford, Pa.

San Francisco, Cal. Houston, Dallas, Greggton, Pampa and Odessa, Texas Seattle, Wash.

FLEXIBILITY

AMMONIA PRODUCTION . .

JM Compressors



Here's one of the neat, compact JM-4 compressors now operating in the Brea Plant. This unit, rated 1000 horsepower at 300 rpm, is used for recycle service.

In the foreground, motor end view of JM-4 used for recycle compression in the Brea Chemicals, Inc. Plant.

● Twelve Cooper-Bessemer JM compressors, totaling 17,500 horsepower, are doing an efficient, economical job of handling a wide range of compressor services in the Brea Chemicals, Inc. 13 million dollar ammonia plant near Los Angeles.

JM-4's for air, ammonia, mixed gas, hydrogen and recycle service, and JM-6's handling nitrogen compression, offer important savings to this producer of 235 tons of ammonia daily.

Here, to list but a few, are reasons why Brea, like so many other modern chemical producers, benefits from Cooper-Bessemer's century of compressing experience: there's extreme flexibility to handle a wide range of pressures and different gases, advanced design and metallurgy afford unusual strength and rigidity, there's five-step unloading at constant speed, the crankshaft is a steel forging of exceptionally large diameter thus low unit bearing pressures, compressor cylinder jackets are designed to insure adequate, uniform cooling, and the JM's exceptional compactness does not sacrifice accessibility or ruggedness.

If you're interested in compressing, write or call for full details . . . learn about *all* the plus features of these modern units. The nearest Cooper-Bessemer office will gladly cooperate.

by **Cooper-Bessemer**

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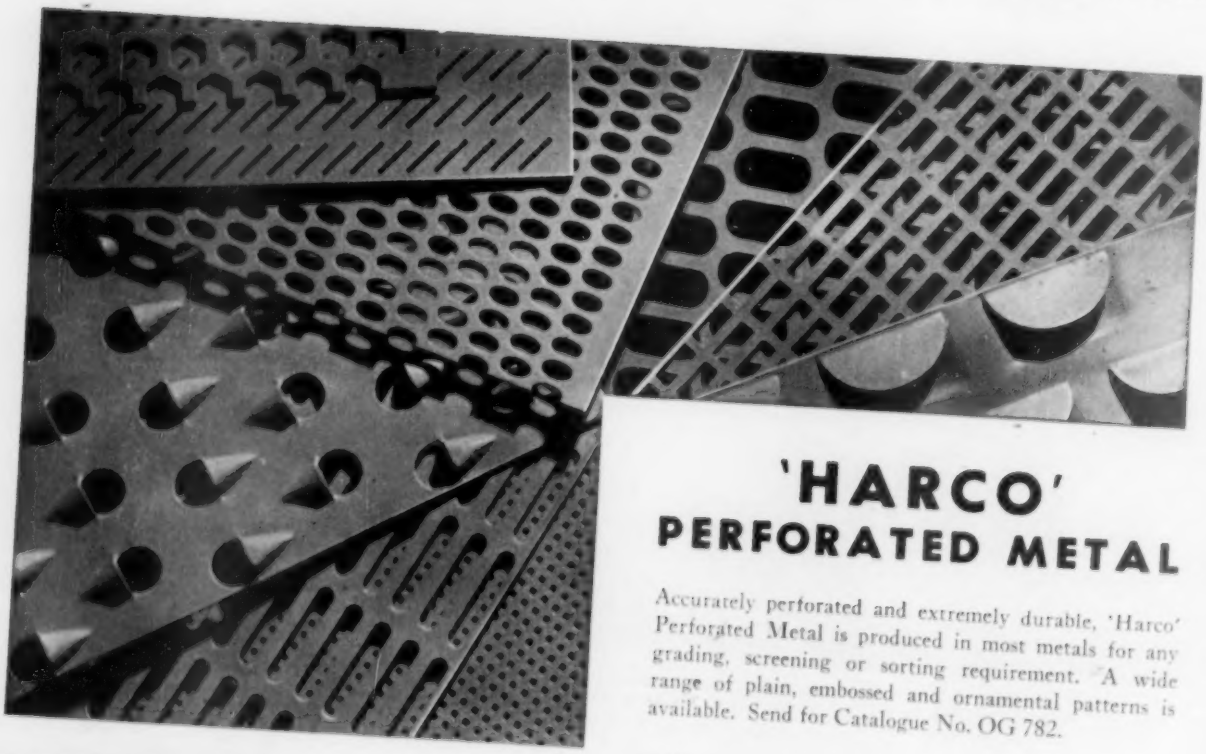

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TEXAS (Continued)

Company and location	Crude capacity	Charge, bbl. per stream day: Vacuum dist.	Thermal operations	Cat cracking—Feed	Cat cracking—Per cent	Cat reforming	Hydrogenation	Production: Alkylation	Polymerization	Lubes (bbl.)	Coke (tons)	Asphalt
Onyx Refining Co.:												
Abilene	6,500		†2,500 ‡2,000			†650			‡130			
Panhandle Oil Corp.:												
Wichita Falls	7,000		†1,600 ‡400	†2,500	25				‡155			
Peerless Tank Cleaning Co.:												
Kilgore	(*)											
Petroleum Products Ref. & Prod. Co.:												
Kilgore	2,000		†1,000									
Petrolite Corp., Ltd.												
Kilgore	700											
Phillips Petroleum Co.:												
Phillips	71,000	17,000	†8,000 ‡28,000 §8,000	†40,000 ‡11,000	5 0	†16,000	*10,000	†6,400	‡750			
Sweeney	85,000	17,000		30,000	20	†6,000		†3,000				
Phoenix Refining Co.:												
San Antonio	3,500											
Pontiac Refining Corp.:												
Corpus Christi	37,000	7,000		8,200	23	†6,000			‡600			
Premier Oil Refining Co.:												
Baird	2,500		†1,200									
Fort Worth	8,000	1,700	†2,200	†5,700	47	†1,700			‡200			
Longview	4,200		†2,200						‡75			
Pure Oil Co.:												
Nederland	67,000	20,000	†15,200	†17,750 ‡9,800	17 48.5			†2,925	†800 ‡825	†2,600		
Rado Refining Co.:												
McAllen	1,500											
Republic Oil Refining Co.:												
Texas City	45,000	20,000	†10,000	†20,000	15	†7,200			‡2,000			
Shamrock Oil & Gas Corp.:												
Sunray	15,500	3,500	†3,500	†11,500	23.5			†3,000				†600
Shell Oil Co.:												
Houston	125,000	43,000	†31,000 ‡14,000	†37,000	4	†15,000		†4,500		†3,300		†500
Sinclair Refining Co.:												
Corpus Christi	29,000		†7,000 ‡3,000	†15,000	25			†1,700				
Houston	138,000	43,000	†5,000 ‡14,000 §12,000	†50,000 ‡11,000	25 10			†2,400		†4,250		
Skelly Oil Co.:												
Longview	7,000		†3,300			†1,800			‡100			
Southwestern Oil & Refining Co.:												
Corpus Christi	50,000	9,000		†7,500		†5,000			‡500			†900
Standard Oil Co. of Texas:												
El Paso	38,000	11,400	†9,000	†15,000	30	†4,300		†1,600				
Suntide Refining Co.:												
Corpus Christi	52,000	13,000		†30,000	35			†2,500	§†400 ‡100			
Texas City Refining, Inc.:												
Texas City	30,000	8,000		†18,000				†3,000				
The Texas Co.:												
Amarillo	*15,000		*†2,000 *‡3,600	*†8,000		*†4,500	*†4,500	*†800	*‡200	*‡100		
El Paso	*13,000		*†2,000 *‡2,800	*†7,000		*†3,500	*†3,500		*‡500	*‡100		
Port Arthur	*230,000	*60,000	*†109,000 *‡17,500 *§7,000	*†60,000		*†40,000	*†40,000	*†12,000	*‡3,800	*†16,000 ‡200		
Port Neches	*40,000	*22,000								‡544		
Texas Gas Corp.:											*†‡	†6,000
Winnie	5,000					†2,500						
Three Rivers Refinery:												
Three Rivers	1,500	500										
Tydal Co.:										†750		†150
Gainesville	2,000									†200		
Wickett Refining Co.:												
Wickett	4,000											
Total‖	2,451,920	532,250	687,841	881,680		283,612	152,090	89,273	32,893	64,730	33,060	

*Barrels per calendar day. †Flashing tank bottoms. ‡Not reported. §Tetramer. ¶1,000 bbl. per day dehydrating unit for tank bottoms. ‖State totals include calendar day figures converted to stream day.

UTAH

Phillips Petroleum Co.:												
Woods Cross	12,500	3,000		†10,000	45				‡400			†1,100
Salt Lake Refining Co.:												
Salt Lake City	37,000	23,500		†8,000 ‡13,000	50 25							
Uinta Oil Refining Co.:												
Jensen	1,200											
Utah Oil Refining Co.:												
Salt Lake City	29,000		†7,200	†16,500	0			3,500	†800	†120		†1,800
Western States Refining Co.:												
North Salt Lake	3,500		†1,500 ‡2,000									
Total	83,200	26,500	10,700	47,500				3,500	1,200	†120		2,900

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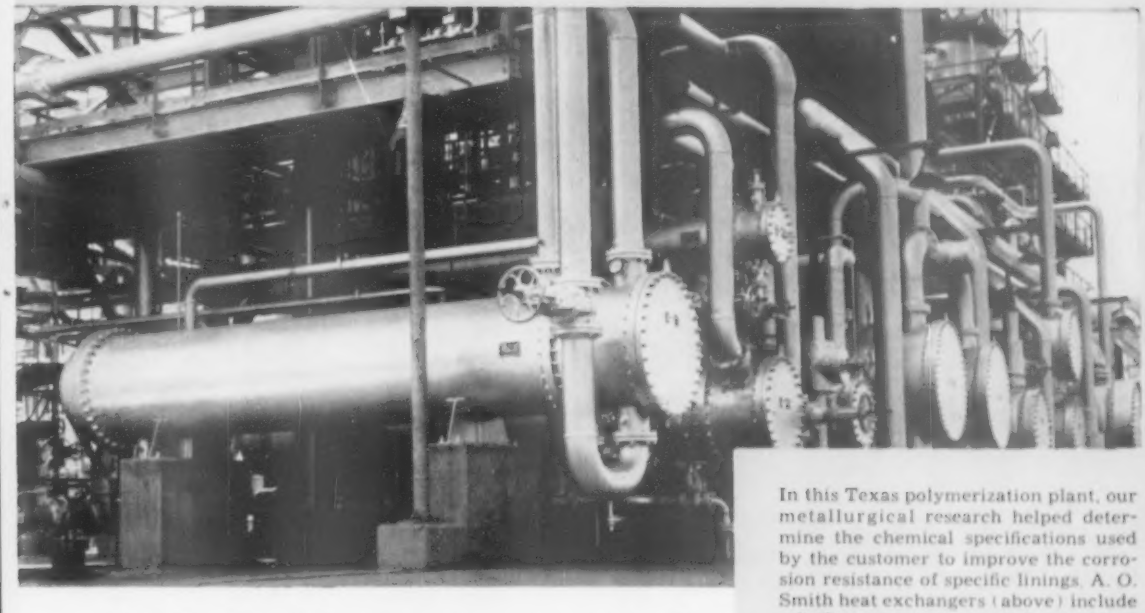
Glascote processing equipment

make steel work for you--



In this Texas polymerization plant, our metallurgical research helped determine the chemical specifications used by the customer to improve the corrosion resistance of specific linings. A. O. Smith heat exchangers (above) include reboilers, condensers, coolers, heaters and exchangers from 15 to 51 in. ID.

A.O. Smith pressure vessels and heat exchangers

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In high-pressure vessels, for example, exclusive A. O. Smith MULTI-LAYER construction offers remarkable safety, economy and flexibility. This patented process features concentric layers of relatively thin steel plate — wrapped, tightened and welded around an inner pressure-tight cylinder which is fabricated in your choice of corrosion-resistant materials. The number of layers used is governed by pressure limits of the application.

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12 plants in New Jersey, Pennsylvania, Ohio, Wisconsin, Illinois, Texas and California

International Division: Milwaukee 1, Wisconsin

WASHINGTON

Company and location	Charge, bbl. per stream day: Crude capacity	Vacuum dist.	Thermal operations	Cat cracking: Feed	Cat cracking: Per cent	Cat re-forming	Hydro-genation	Production: Alkylation	Polymerization	Lubes (bbl.) coke (tons)	Asphalt
American Bitumuls & Asphalt Co.:											
Richmond Beach	3,500	3,500									[1]2,600 [2]1,500
General Petroleum Corp.:											
Ferndale	37,000	10,000	[2]6,600	[2]20,000	40	[1][6]6,000			[2]1,000		
Shell Oil Co.:											
Anacortes	50,000	19,000		[1]22,000	0	[1]8,000	[4]8,000		[2]3,800		
Union Oil Co. of California:											
Edmonds	5,000										[1]3,500 [2]600
Total	95,500	32,500	6,600	42,000		14,000	8,000		4,800		8,200

WEST VIRGINIA

Elk Refining Co.:											
Falling Rock	4,500	1,500	[1]1,500			[1]1,500	[1]500		[2]100	[1]1,200	
Quaker State Oil Refining Co.:											
St. Marys	2,800		[1]750 [2]600			[1]1,000			[2]75	[1]600	
Total	7,300	1,500	2,850			2,500	500		175	[1]1,800	

WISCONSIN

Empire Petroleum Co. (was Wisconsin Oil Refining Co., Inc.):											
Sheboygan	5,000					[1]2,500					
Lake Superior Refining Co.:											
Superior	6,000	5,000	[1]1,500			[1]1,000			[2]100		[1]3,000 [2]1,500
Total	11,000	5,000	1,500			3,500			100		4,500

WYOMING

C & H Refinery:											
Lusk	200										
Continental Oil Co.:§											
Glenrock	4,100		[2]2,200						[2]125		
Crook County Refinery:											
Sundance	125										
Empire State Oil Co.:											
Thermopolis	5,000										
Frontier Refining Co.:											
Cheyenne	15,000	2,500	[1]3,500	[1]8,000	20	[1]2,000	[1]3,000		[1]500		[1]1,400
Husky Oil Co.:											
Cody	7,000	4,000				[2]1,500	[6]1,000				[1]2,000 [2]500 [3]500
Ohio Oil Co. (was Petroleum Operators Corp.):¶											
Lovell	6,000			[2]750	0						[1]1,800
Pilot Oil Co.:											
Morton	250										
Sinclair Refining Co.:											
Sinclair	24,000	9,000	[2]2,000 [2]2,000	[1]12,500	25			[1]1,700	[2]350		[2]750
Sioux Oil Co.:											
Newcastle (2 refineries)	4,000		[1]2,000						[2]50		
Socony Mobil Oil Co., Inc.:											
Casper	13,600			[2]7,800	50				[2]300		[1]1,300
Standard Oil Co. (Ind.):											
Casper	21,000	7,000	[1]4,450 [2]2,500	[1]8,750	3.9	[4]3,750		[1]800		[1]650 [2]118	[1]115 [2]30 [3]1,955
The Texas Co.:											
Casper	*17,000	*9,000	*[2]1,500 *[4]4,000	*[1]6,000					*[2]500	*[2]100	*[1] [2] [3]1,400
Total†	118,545	32,490	24,755	44,460		7,250	4,000	2,500	1,880	[1]650 [2]229	11,904

*Barrels per calendar day. †State totals include calendar day figures converted to stream day. ‡To be shut down summer of 1956. §Shut down January 6, 1956. ¶To be shut down summer of 1956.

PUERTO RICO

Caribbean Refining Co.:											
Bayamon	13,500	9,000		[1]13,100	43				[2]500		
Commonwealth Oil Refining Co., Inc.:											
Guayanilla Bay	23,500	17,000		[2]26,800		[2]3,700		[1]1,400	[2]900		
Total	37,000	26,000		39,900		3,700		1,400	1,400		

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OPERATING HEADS	up to 625 feet
CASE PRESSURES	up to 400 psig
DRIVES	horizontal electric motor is standard; other types as required
MATERIAL OF CONSTRUCTION	liquid end can be of any material suitable to intended service

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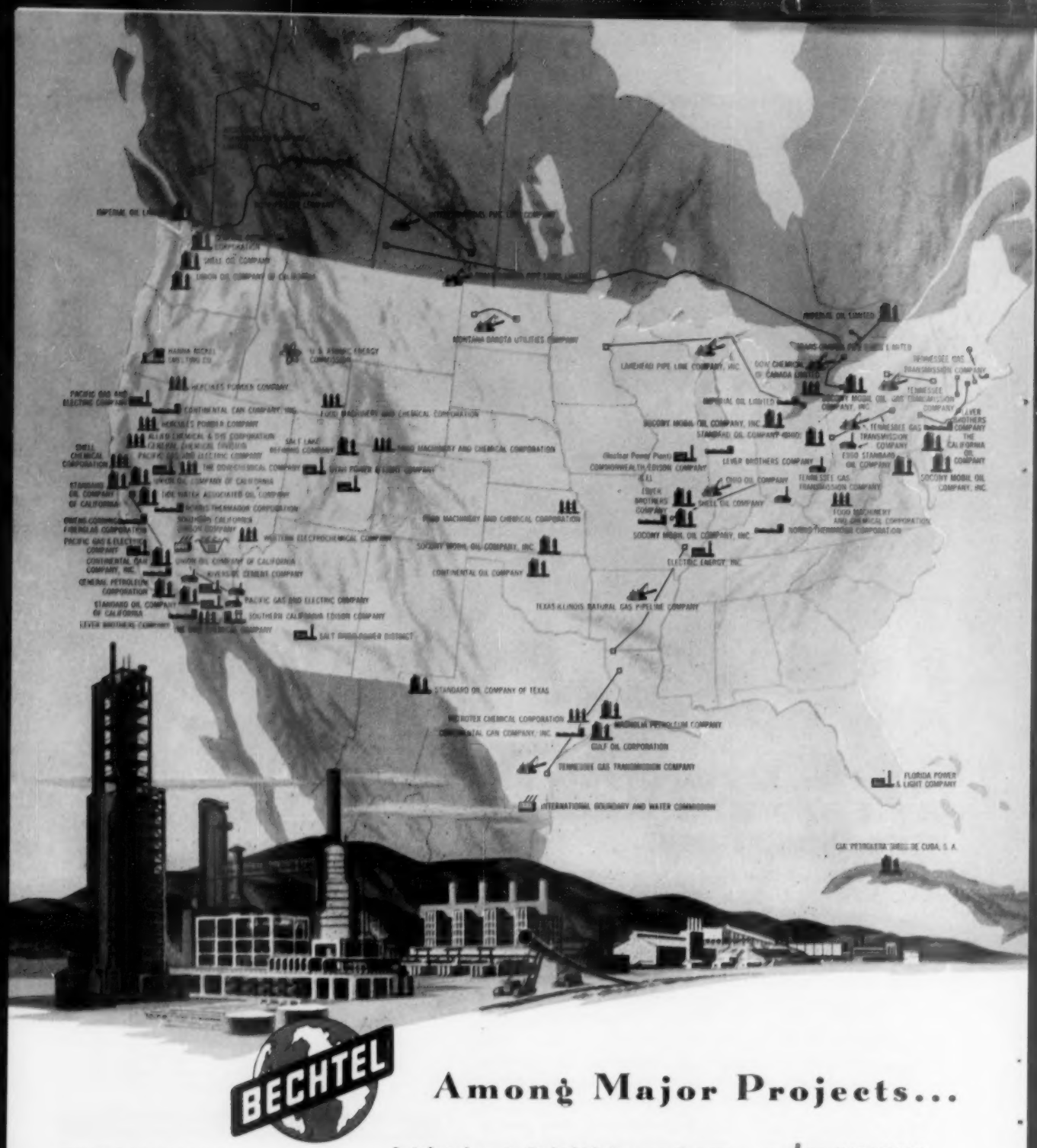
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Report on Canadian Operating Refineries

. . . DISTRIBUTION AND CAPACITIES

(Capacity, barrels per stream day)

Province	No. plants	Crude capacity	Vacuum dist.	Thermal operations	Catalytic cracking	Cat reforming	Hydrogenation	Alkylation	Polymerization	Lubes[1] (bbl.) Coke[2] (tons)	Asphalt
Alberta	10	84,162	7,000	29,907	22,640	5,220	2,731	833	320	[1]2,220 [2]120	10,325
British Columbia	4	66,530	16,340	4,500	37,150	2,750			3,797		6,276
Manitoba	4	31,530	5,000	1,375	14,550	1,000			1,450		250
New Brunswick	1	300									
Northwest Territory	1	1,388									
Nova Scotia	1	19,980		11,100							103
Ontario	6	166,230	20,000	58,120	80,110	10,630	666		1,760	[1]5,660 [2]266	5,445
Quebec	5	240,150	54,700	43,482	124,200	28,000	3,000	1,426	8,555	[1]330	10,999
Saskatchewan	9	70,375	20,300	19,486	45,900	660	1,000		1,923	[2]100	6,433
Total	41	680,645	123,340	167,970	324,550	48,800	7,397	2,259	17,805	[1]8,210 [2]486	39,836

*ALBERTA

Company and location	Crude capacity	Charge, bbl. per stream day: Vacuum dist.	Thermal operations	Cat cracking—Feed	Cat cracking—Per cent	Cat reforming	Hydrogenation	Production: Alkylation	Polymerization	Lubes (bbl.) coke (tons)	Asphalt
Anglo American Exploration, Ltd.:											
Hartell	4,000		†1,500			†1,000			†70		†200
Bonnyville Oil Refining:											
Bonnyville	1,000										
British American Oil Co., Ltd.:											
Calgary	7,200	2,500	†2,500			2,000					†600
Edmonton	7,000		†1,400 ‡2,100	†4,000	50					†60	
Excelsior Refineries, Ltd.:											
Lloydminster	2,500	1,000									†1,200 ‡1,200
Husky Oil & Refining, Ltd.:											
Lloydminster	8,500	1,500		†1,500	0						†4,600 ‡1,500
Imperial Oil, Ltd.:											
Calgary	*9,200		*†4,600					*†750			*†‡923
Edmonton	*25,000		*†9,100	†12,140	30	*†2,000	*†2,460			*†2,000	
McColl Frontenac Oil Co., Ltd.:											
Edmonton	13,000		†3,000 ‡2,200	†5,000	30				†250	†60	
Wainright Producers & Refining, Ltd.:											
Wainright	3,000	2,000	†2,000								
Total†	84,162	7,000	29,907	22,640		5,220	2,731	833	320	[1]2,220 [2]120	10,325

*Barrels per calendar day. †Province totals include calendar day figures converted to stream day.

BRITISH COLUMBIA

Company and location	Crude capacity	Charge, bbl. per stream day: Vacuum dist.	Thermal operations	Cat cracking—Feed	Cat cracking—Per cent	Cat reforming	Hydrogenation	Production: Alkylation	Polymerization	Lubes (bbl.) coke (tons)	Asphalt
Imperial Oil, Ltd.:											
Ioco	*23,000			†18,400	55				*†2,340		*†‡627
Royalite Oil Co., Ltd.:											
Kamloops	5,000	2,000		†3,750	60				†500		†500
Shell Oil Co. of Canada, Ltd.:											
North Burnaby	18,000	8,000	†3,000 ‡1,500	†7,500	33.3				†400		†3,000
Standard Oil of British Columbia, Ltd.:											
North Burnaby	18,000	6,340		†7,500	50	2,750			†340		†2,080
Total†	66,530	16,340	4,500	37,150		2,750			3,797		6,276

*Barrels per calendar day. †Province totals include calendar day figures converted to stream day.

MANITOBA

Company and location	Crude capacity	Charge, bbl. per stream day: Vacuum dist.	Thermal operations	Cat cracking—Feed	Cat cracking—Per cent	Cat reforming	Hydrogenation	Production: Alkylation	Polymerization	Lubes (bbl.) coke (tons)	Asphalt
Anglo-Canadian Oil, Ltd.:											
Brandon	3,100		†1,375			†1,000			†50		
Imperial Oil, Ltd.:											
Winnipeg	*13,000			†6,250	29						*†‡225
North Star Oil, Ltd.:											
St. Boniface	12,000	5,000		†8,300	45				†1,400		
Radio Oil:											
East Kildonan	2,000										
Total†	31,530	5,000	1,375	14,550		1,000			1,450		250

*Barrels per calendar day. †Province totals include calendar day figures converted to stream day.

Ciment Fondu is a high quality high-alumina cement and its manufacturers, Lafarge Aluminous Cement Co. Ltd. are by far the largest individual producers in the World. The name of Lafarge has been associated with the manufacture of lime and cements for 125 years and Ciment Fondu is to-day in continuous use throughout industry on all five continents. This proud record is maintained through a combination of long experience, manufacturing know-how and a determination to remain acknowledged as producers of The Best Cement in the World.

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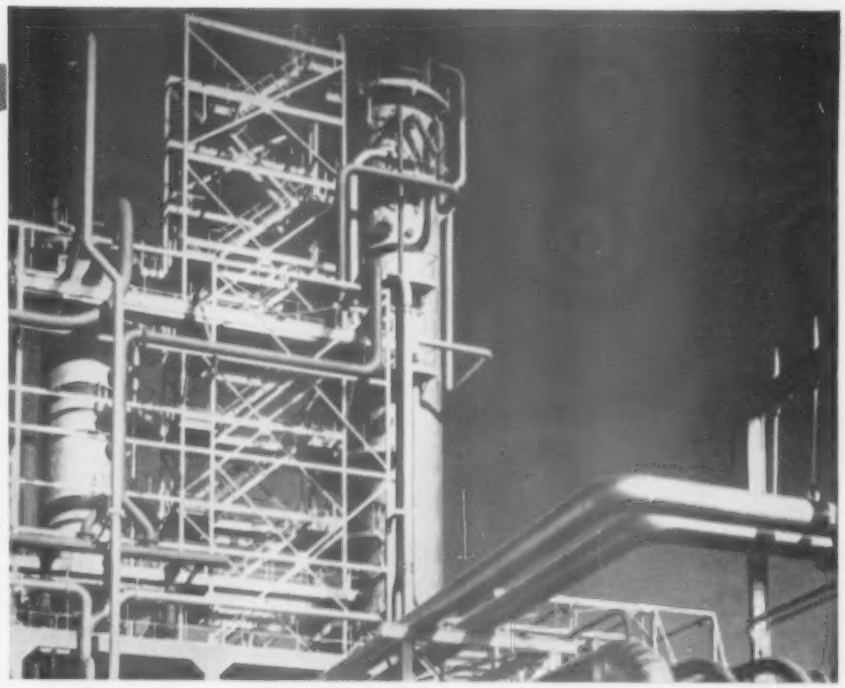
Speed, Strength, Resistance, Refractoriness

No other type of cement combines all these advantages. High-Alumina is stronger —hardens more rapidly. For many purposes concrete can safely be put into use within a few hours of placing and is ready for any purpose in 24 hours. High-Alumina is completely immune from attack by sulphates and highly resistant to sulphuric acids. High-Alumina produces Refractory Concrete stable to 2500°F., Non-spalling; Non-shrinking.

CIMENT FONDU is available throughout the World in any standard bag or steel drum.

Special uses for the Oil Industry include :—

Internal insulation of regenerators
Lining flash columns in cracking plants
Lining tower shell in cracking plants
Lining reaction vessels
Piles
Burner blocks etc.
Filling Drilling shoes
Flare tips
Lining vacuum condenser receiver drums
Lining cone section of vacuum tower
Lining barometric condenser at bench
Lining fractionating towers
Lining overhead receivers at stabilisers
Linings for protecting steel in bubble towers and vaporisers
Facing of tube sheets (insulating concrete) in oil still furnaces
Retaining safety walls in Refractory Concrete scrubber linings
Heat resistant foundations and hearths and floors
Furnace flues: ducts: stacks
Vermiculite/C.F. for spraying furnace stanchions
Mortar for brick laying
Tank and pipe linings to protect against sour crudes

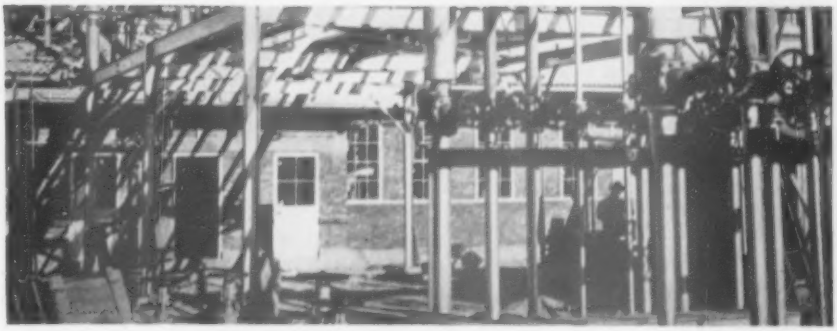


ABRIDGED LIST OF PLANTS IN WHICH CIMENT FONDU HAS BEEN USED :—

Aden Petroleum Refinery Ltd., Aden.
Anglo Egyptian Oilfields Ltd., Suez.
Assam Oil Co. Ltd., Digboi Refinery, India.
Arabian American Oil Co., Saudi Arabia.
Australian Oil Refining Ltd., Kurwell Refinery, Sydney.
Australasian Petroleum Refinery Ltd., Kwinana.
Bahrein Petroleum Co. Ltd., Bahrein.
Basrah Petroleum Co. Ltd., Basrah, Iraq.
Berry Wiggins & Co. Ltd., Kingsnorth Refinery.
Burmah Shell Refineries Ltd., Bombay, India.
B.P. Benzin-und Petroleum - G.m.b.H. Refinery, Hamburg.
Caltex Petroleum Maatschappij, Rotterdam.
Canadian Petrofina Ltd., Montreal, Quebec.
Compania Shell de Venezuela Ltd., Cardon Refinery.
Consolidated Oil Refineries Ltd., Haifa.
Diadema Argentine S.A. de Petroleo, Buenos Aires.

for the OIL INDUSTRY

Esso Petroleum Co. Ltd., Fawley Refinery.
Grangemouth Petroleum Refinery Ltd., Grangemouth.
Imperial Oil Co. Ltd., Ontario, Canada.
Industria Raffinazione Olii Minerali, S.P.A. Porto Marghera, Venice.
Iraq Petroleum Co. Ltd., Iraq.
Iranian National Oil Co. Ltd., Abadan.
Kent Oil Refinery Ltd., Isle of Grain.
Lobitos Oilfields Ltd., Ellesmere Port.
McColl Frontenac Oil Co., Montreal, Quebec.
Manchester Oil Refinery Ltd., Trafford Park.
National Oil Refineries Ltd., Llandarcy, Wales.
N.V. de Bataafsche Petroleum Mij, Balik Papen, Indonesia.
N.V. Curacaosche Petroleum Industrie, Mij.
N.V. de Bataafsche Petroleum Mij, Pladjoe Refinery, Indonesia.
N.V. Nederlandsche Nieuw Guinea Petroleum Mij, Sorong.
N.V. de Bataafsche Petroleum Maatshappij, Pernis Refinery.
Sarawak Oilfields Ltd., Labuan, Borneo.
Shell Co. of Australia Ltd., Geelong Refinery.
"Shell" Refining and Marketing Co. Ltd., Shellhaven.
"Shell" Refining and Marketing Co. Ltd., Stanlow.
Standard Oil Co. of British Columbia, Vancouver.
Trinidad Leaseholds Ltd., Trinidad.
Vacuum Oil Co. Ltd., Coryton Refinery.



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NEW BRUNSWICK

Company and location	Crude capacity	Charge, bbl. per stream day: Vacuum dist.	Thermal operations	Cat cracking—Feed	Cat cracking—Per cent	Cat re-forming	Hydro-genation	Production: Alkylation	Polymerization	Lubes (bbl.) coke (tons)	Asphalt
New Brunswick Oilfields, Ltd.:											
Weldon	300										

NORTHWEST TERRITORY

Imperial Oil, Ltd.:											
Norman Wells	*1,250										
Total†	1,388										

*Barrels per calendar day. †Province totals include calendar day figures converted to stream day.

NOVA SCOTIA

Imperial Oil, Ltd.:											
Halifax	*18,000		*‡10,000								*‡‡93
Total†	19,980		11,100								103

*Barrels per calendar day. †Province totals include calendar day figures converted to stream day.

ONTARIO

British American Oil Co., Ltd.:											
Clarkson	21,500	6,000	‡4,500	‡17,400	33				‡1,260	‡1,220	‡1,500 ‡500
Canadian Oil Companies, Ltd.:											
Sarnia	25,000	12,500	‡3,000	‡20,500	44	‡4,000			‡500		
Husky Oil & Refining, Ltd.:											
Ft. William	2,500	1,500				‡1,000					‡1,000
Imperial Oil, Ltd.:											
Sarnia	*78,000		*‡4,000 *‡4,000 *‡8,000 *‡26,000	‡30,000	30		*‡600			*‡4,000 *‡240	*‡‡2,203
Regent Refining (Canada), Ltd. (Was Trinidad Leaseholds, Ltd.):											
Port Credit	14,000		‡4,000			‡2,300					
Sun Oil Co., Ltd.:											
Sarnia	*15,000			*‡11,000		*‡3,000					
Total†	166,230	20,000	58,120	80,110		10,630	666		1,760	5,660 ‡266	5,445

*Barrels per calendar day. †Province totals include calendar day figures converted to stream day.

QUEBEC

British American Oil Co.:											
Montreal East	45,000	12,000		‡22,000	18	‡13,000			‡630	‡330	‡5,000 ‡2,000
Canadian Petrofina, Ltd.:											
Montreal East	20,000	9,700		‡16,000	60	‡3,600	‡3,000	‡1,426	‡230		
Imperial Oil, Ltd.:											
Montreal East	*65,000		*‡12,000 *‡4,200	‡31,700	40				*‡4,500		*‡‡3,603
McColl Frontenac Oil Co., Ltd.:											
Montreal East	58,000		‡4,500 ‡12,000	‡30,000	20	‡12,000			‡1,500		
Shell Oil Co. of Canada, Ltd.:											
Montreal East	45,000	33,000	‡9,000	‡24,500	17				‡1,200		
Total†	240,150	54,700	43,482	124,200		28,600	3,000	1,426	8,555	‡330	10,999

*Barrels per calendar day. †Province totals include calendar day figures converted to stream day.

SASKATCHEWAN

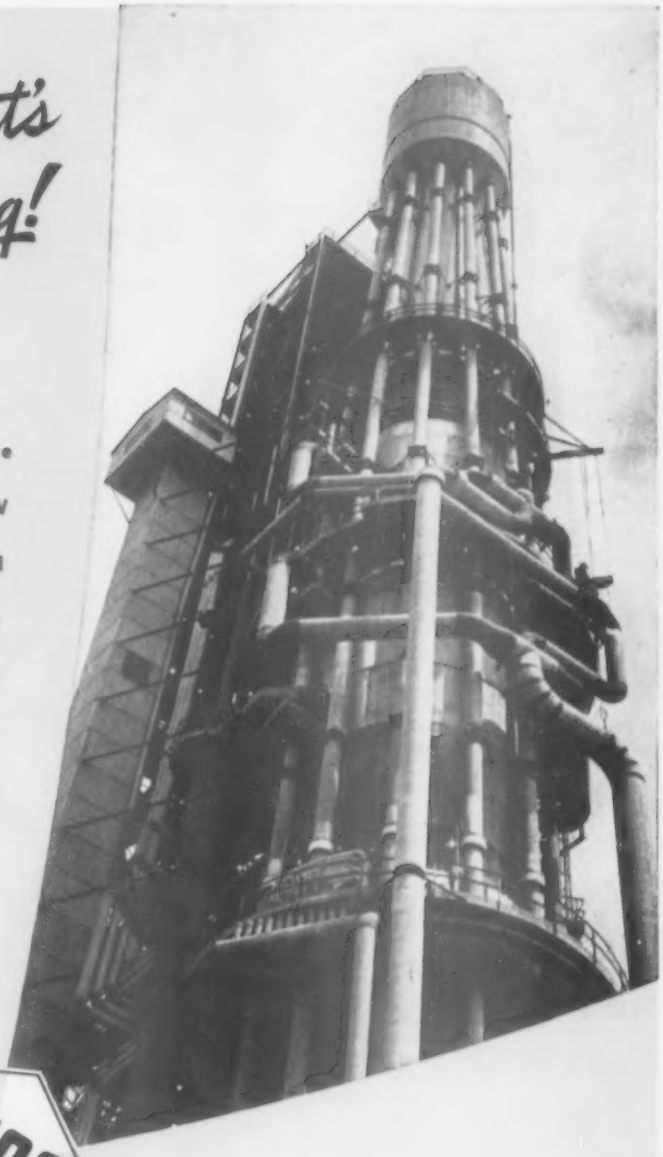
British American Oil Co., Ltd.:											
Moose Jaw	15,000	5,500	‡1,500 ‡2,250	‡10,000	55				‡390	‡100	‡1,200
Consumers Co-op Refineries, Ltd.:											
Regina	13,000	6,500	‡3,000	‡10,000	50				‡500		
Husky Oil & Refining, Ltd.:											
Moose Jaw	3,000	1,500	‡1,500			‡600	‡1,000				‡1,000 ‡500
Imperial Oil, Ltd.:											
Regina	*22,500		*‡7,600	‡19,400	55				*‡300		*‡‡214
Northern Petroleum Corp., Ltd.:											
Kamsack	800										
Petroleum Fuels:											
Moose Jaw	1,100										
Prince Albert Refineries, Ltd.:											
Prince Albert	1,000										‡500
Royalite Hi-Way, Ltd.:											
Saskatoon	6,500	2,800	‡2,800	‡6,500	60				‡700		‡500
Royalite Oil Co., Ltd.:											
Coleville	5,000	4,000									‡2,500
Total†	70,375	20,300	19,486	45,900		600	1,000		1,923	‡100	6,438

*Barrels per calendar day. †Province totals include calendar day figures converted to stream day.

Well, now... that's very interesting!

but what is it?

By now, many refiners would recognize this giant as the new HOUDRIFLOW unit of the SUN OIL COMPANY located in Marcus Hook, Pa. Equivalent in height to 35 stories . . . 30,000 bbl./day capacity . . . this cat-cracker (only the upper half of which is shown here) was erected at a cost of approximately eight million dollars. It is the largest unit of its type in the world.



SUNOCO

And in the Quench Section and Vacuum Section this mighty "cat" chose Western Heat Exchangers constructed of alloy steel. Western backed its bid for this business with service that helped put the big HOUDRIFLOW on stream as scheduled.

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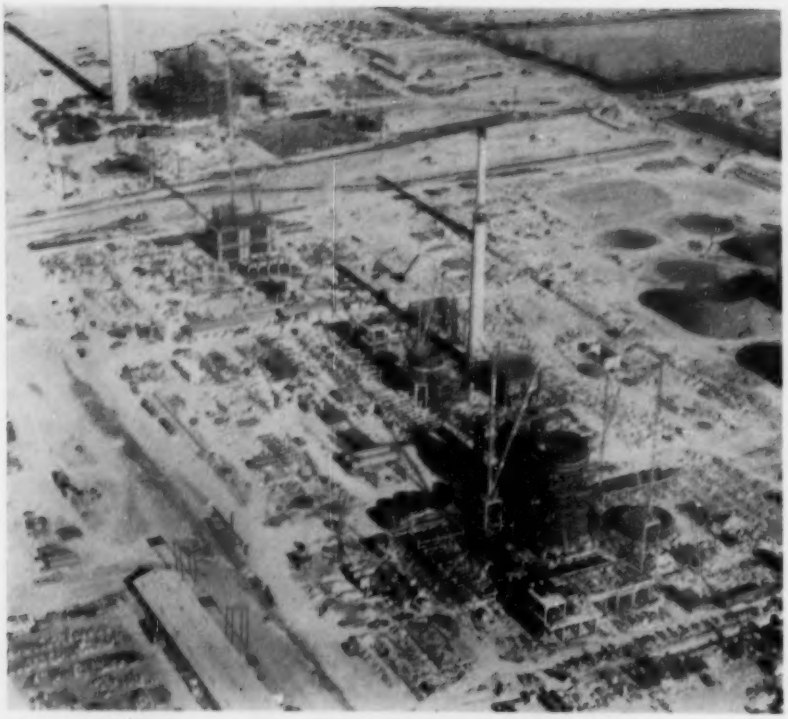
H. W. SEVERANCE—Marion E. Taylor Bldg., Louisville, Ky.



MAIN PROCESS AREA of Tide Water Associated Oil Co.'s new 130,000-bbl. refinery, being built 15 miles south of Wilmington, Del. It will have the largest initial capacity of any refinery yet built.

Who's Building and Where

Here's a complete rundown on construction activity in U. S. and Canadian refineries

THIS will be a banner year for refinery construction in the United States, and the boom will continue into 1957.

That's the story behind our annual construction survey, given in detail below. There will be a healthy boost in crude capacity, and comparatively greater increases in catalytic reforming, catalytic cracking, and hydrogen-treating capacities.

Modest increases are also scheduled for alkylation, polymerization, lubes, coke, and asphalt.

Crude throughput . . . The nation's refineries will be able to process a little more than 9,300,000 bbl. of crude oil daily on January 1, 1957. This is a net increase of some 450,000 bbl. over the total capacity of 8,958,000 on January 1, 1956.

The increase this year is the continuation of a steady growth during postwar years. Crude capacity totaled 7,500,000 bbl. for 1953, 8,400,000 bbl. for 1954, and 8,640,000 bbl. for 1955.

Catalytic reforming . . . The boom is continuing in catalytic reforming. Discounting capacity that will be shut down or changed over to other processing, the net increase in capacity during 1956 is expected to be nearly 310,000 bbl. per day.

Total U. S. capacity should stand at just over 1,235,000 bbl. per day on January 1, 1957. This compares with capacities of 136,000 for 1953, 250,000 for 1954, 569,000 for 1955, and 926,000 for 1956.

Catalytic cracking . . . Total U. S. catalytic cracking capacity is expected to top 4,000,000 bbl. by January 1, 1957. Capacities on January 1 for the last 4 years stood at 2,400,000 bbl. in 1953, 2,800,000 bbl. in 1954, 3,300,000 bbl. in 1955, and 3,709,000 bbl. in 1956.

A

Company, location of refinery, and type of project—	Capacity or prod. rating (bbl. per stream day)	Completion schedule
American Oil Co., Savannah, Ga.:		
Adding oxidized asphalt capacity	700	6/56
American Oil Co., Texas City, Tex.:		
Building hydrodesulfurization unit	5,000	6/56
American Oil Co., Yorktown, Va.:		
Building new refinery		Early 1957
Crude capacity	35,000	
Vacuum capacity	19,000	
Delayed coking	9,600	
Fluid catalytic cracking (30% recycle)	30,600	
Ultraforming	7,600	
Catalytic hydrodesulfurization	22,600	
Catalytic polymerization	2,500	
Coke capacity, tons per day	600	
Anderson-Prichard Oil Corp., Cyril, Okla.:		
Building fluid catalytic cracker (45% recycle)	9,000	
Building Unifining unit	1,000	
Ashland Oil & Refining Co., Catlettsburg, Ky.:		
Adding crude capacity	20,000	9/56
Building fluid catalytic cracker (33% recycle) to replace present 25,000-bbl. per day T.C.C. unit	36,000	8/56
Ashland Oil & Refining Co., N. Tonawanda, N. Y.:		
Planning catalytic reformer, platinum type	6,000	11/56
Building hydrodesulfurization unit	8,500	11/56
Atlantic Refining Co., Philadelphia:		
Building Catformer (bbl. per calendar day)	13,500	7/57
Building Unifining unit (bbl. per calendar day)	13,500	7/57
Atlantic Refining Co., Port Arthur, Tex.:		
Planning Catformer (bbl. per calendar day)	13,500	
Planning Unifining unit (bbl. per calendar day)	13,500	
Aurora Gasoline Co., Detroit, Mich.:		
Building fluid coker	4,000	5/56
Coke capacity, tons per day	100	5/56
Converting Platformer to Rexformer	7,000	4/56
Building Unifining unit	10,000	1/56
Aurora Gasoline Co., Muskegon, Mich.:		
Adding vacuum capacity	6,000	12/56
Adding fluid cat cracker (10% recycle)	7,000	2/57

. . . and IBM electronics

Speed . . . speed . . . speed!!
Speed in pinpointing and forecasting market demands for petroleum products!
Speed in shifting refinery operations to meet these demands!
Speed in determining mix formulas to produce the *right* products at the *right* time!

Yes, the speed and accuracy of IBM Data Processing Systems have proved to be turning points toward greater efficiency and profits by many refineries.

One refinery, for example, using the IBM 650 "electronic workhorse" on a daily basis for Gasoline Blending, estimates a saving of ½¢ per barrel!

Another producer, using one of IBM's Data Processing Centers for Refinery Simulation, is now able to reschedule operations in minutes, rather than days, —to meet market forecasts.

In another instance, several refineries were able to switch Chemical Engineers to more vital work. Formerly, it required 2 or more of these engineers' full time to make Mass Spectrometer Calculations. Today, this job is done on the IBM 650 . . . in 20 minutes!

Here is a partial list of other proven applications of these machines:

- Crude Oil Analysis and Evaluation
- Product Outlook
- Refinery Scheduling
- Yield and Cost Calculations
- Correlation and Multiple Regression Analysis
- Flash Vaporization
- Catalytic Cracking and Thermal Cracking Calculations
- Reactor Design
- Acid Distribution and Consumption

For detailed information on how IBM electronics will profit your refinery, call your local IBM representative today, or write: PETROLEUM DEPARTMENT A56, International Business Machines Corp., 590 Madison Ave., N.Y. 22, N.Y.

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B

Company, location of refinery, and type of project—	Capacity or prod. rating (bbl. per stream day)	Completion schedule
Bankline Oil Co., Bakersfield, Calif.:		
Adding crude capacity	2,000	7/56
Building alkylation unit	1,500	7/56
Building fluid coking unit	4,000	9/56
Building Sinclair-Baker catalytic reformer	4,000	1/57
Coke capacity, tons per day	40	9/56
Bay Petroleum Co., Chalmette, La.:		
Adding crude capacity	4,000	7/56
Adding vacuum capacity	1,600	7/56
Adding visbreaker capacity	1,600	7/56
Building fluid catalytic cracking unit (33% recycle)	12,000	7/56
Building Platformer	5,000	7/56
Bay Refining Corp., Bay City, Mich.:		
Adding crude capacity	1,500	5/56
Bell Oil & Gas Co., Grandfield, Okla.:		
Adding Platforming capacity	300	
Ben Franklin Refining Co., Ardmore, Okla.:		
Adding to fluid catalytic cracking capacity (45% recycle)	500	
British American Oil Co., Ltd., Clarkson, Ont., Canada:		
Building Catformer	10,000	Early 1957
British American Oil Co., Ltd., Montreal East, Que., Canada:		
Building Unifining unit	15,500	Early 1957

C

California Oil Co., Perth Amboy, N. J.:		
Adding Platformer capacity	2,500	11/56
Caminol Co., Hanford, Calif.:		
Planning catalytic reformer	1,000	1956
Canadian Oil Companies, Ltd., Sarnia, Ont., Canada:		
Adding crude capacity	5,000	5/56
Adding catalytic polymerization capacity	100	10/56
Adding fluid catalytic cracking capacity (40% recycle)	1,500	5/56
Adding Platforming capacity	500	5/56
Adding vacuum capacity	2,500	5/56
Canadian Petrofina, Ltd., Montreal East, Que., Canada:		
Building fluid coking unit	3,600	
Coke capacity, tons per day	140	
Caribbean Refining Co., Bayamon, Puerto Rico:		
Building sulfur-recovery unit, tons per day, sulfur	12	
Century Refining Co., Shallow Water, Kans.:		
Adding to Cycloversion catalytic cracking capacity	1,000	
Champlin Refining Co., Enid, Okla.:		
Adding crude capacity	8,000	4/56
Adding vacuum capacity	5,000	4/56
Cities Service Oil Co. (Del.), Ponca City, Okla.:		
Adding crude capacity	11,500	1/57
Adding vacuum capacity	3,500	1/57
Adding fluid catalytic cracking capacity (28% recycle)	5,000	1/57
Building Rexformer	6,000	1/57
Col-Tex Refining Co., Colorado City, Tex.:		
Building Unifining unit	1,800	
Commerce Oil & Refining Co., Portsmouth, R. I.:		
Planning new refinery	30,000	
Continental Oil Co., Westlake, La.:		
Adding F.C.C. capacity (12.5% recycle)	7,000	
Continental Oil Co., Artesia, N. M.:		
Building Houdriforming unit	1,500	6/56
Cooperative Refinery Association, Coffeyville, Kans.:		
Building Platformer	4,500	5/56
Building Unifining unit	3,000	5/56
Building delayed coker	8,400	9/56
Adding fluid catalytic cracking capacity	1,250	8/56
Adding polymerization capacity	150	
Coke capacity, tons per day	100	8/56
Cosden Petroleum Corp., Big Spring, Tex.:		
Building Rexformer	3,900	
Building polymerization unit	400	

D

Company, location of refinery, and type of project—	Capacity or prod. rating (bbl. per stream day)	Completion schedule
Delta Refining Co., Memphis, Tenn.:		
Adding crude capacity	8,000	Late 1956
Planning Platformer	2,200	
Derby Oil Co., Wichita, Kans.:		
Building Ultraformer (expandable to 4,000)	2,500	6/56
Building hydrodesulfurization unit (expandable to 4,000)	2,500	6/56
D-X Sunray Oil Co., Duncan, Okla.:		
Adding crude capacity	5,000	7/56
Adding vacuum capacity	2,000	7/56
Adding fluid catalytic cracker (16% recycle)	3,500	3/56

E

El Dorado Refining Co., El Dorado, Kans.:		
Building Platforming unit	2,500	3/56
Adding to oxidized asphalt capacity	300	3/56
El Paso Natural Gas Products Co., Bloomfield, N. M. (formerly Malco Refineries, Inc.):		
Adding crude capacity	500	9/56
El Paso Natural Gas Products Co., Brickland, N. M. (formerly McNutt Oil & Refining Co., Inc.):		
Adding crude capacity	1,000	Mid 1956
Adding thermal cracking capacity	400	Mid 1956
Adding thermal polymerization capacity	40	Mid 1956
El Paso Natural Gas Products Co., Prewitt, N. M. (formerly Malco Refineries, Inc.):		
Adding thermal cracking capacity	500	
Adding crude capacity	1,000	
Empire Petroleum Co., Denver, Colo.:		
Building hydrodesulfurization unit	1,000	6/56
Empire Petroleum Co., Sheboygan, Wis. (formerly Wisconsin Oil Refining Co., Inc.):		
Adding vacuum capacity	2,000	5/56
Adding straightrun asphalt capacity	2,000	5/56
Esso Standard Oil Co., Linden, N. J.:		
Adding fluid catalytic cracking capacity (32% recycle)	13,700	7/56

F

Farmers Union Central Exchange, Inc., Laurel, Mont.:		
Adding crude capacity	1,500	4/56
Frontier Refining Co., Cheyenne, Wyo.:		
Adding crude capacity	4,000	4/56

G

Golden Bear Oil Co., Bakersfield, Calif.:		
Adding crude capacity	1,000	1956-57
Planning catalytic hydrogen treating unit	500	1956-57
Gulf Oil Corp., Philadelphia, Pa.:		
Building Platformer	23,400	
Building Gulfining unit	40,000	1956
Adding sulfuric alkylation capacity	3,000	
Gulf Oil Corp., Port Arthur, Tex.:		
Adding crude capacity	74,400	1956
Adding vacuum capacity	30,000	1956
Building fluid catalytic cracker	54,000	1956
Building Gulfining unit	40,000	1956
Adding sulfuric alkylation capacity	4,500	1956

H

Hancock Oil Co., Signal Hill, Calif.:		
Adding crude capacity	7,000	7/56
Adding vacuum capacity	15,750	7/56
Adding visbreaking capacity	3,450	7/56
Adding TCC catalytic cracking capacity (48% recycle)	2,100	7/56
Building Ultraforming unit	3,000	7/56
Building naphtha hydrodesulfurization unit	3,000	7/56
Humble Oil & Refining Co., Baytown, Tex.:		
Adding sulfuric alkylation capacity	1,300	8/56
Adding lube capacity	1,400	10/56
Husky Oil & Refining, Ltd., Fort William, Ont., Canada:		
Adding crude capacity	1,500	7/56
Adding oxidized asphalt capacity	500	7/56

I

Imperial Oil, Ltd., Ioco, B. C., Canada:		
Building Powerforming unit	3,300	1956

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This treatment packs a one-two punch

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REFINERY-BUILDING SURVEY

Company, location of refinery, and type of project—	Capacity or prod. rating (bbl. per stream day)	Completion schedule
Imperial Oil, Ltd., Halifax, N. S., Canada:		
Building atmospheric and vacuum crude unit (bbl. per calendar day)	41,625	1956
Building visbreaker unit (bbl. per calendar day)	10,625	1956
Building thermal naphtha reforming unit (bbl. per calendar day)	3,100	1956
Building fluid catalytic cracking unit (bbl. per calendar day)	15,200	1956
Building catalytic polymerization unit (bbl. per calendar day)	4,000	1956
Imperial Oil, Ltd., Sarnia, Ont., Canada:		
Building Powerforming unit	13,500	1956
Imperial Oil, Ltd., Montreal East, Que., Canada:		
Building Powerforming unit	9,000	1957
Indiana Farm Bureau Cooperative Association, Inc., Mount Vernon, Ind.:		
Building Platformer	3,000	8/56
Building Unifining unit	2,100	8/56
Adding crude capacity	2,500	8/56
Ingram Oil & Refining Co., Mereaux, La.:		
Adding crude capacity	2,000	5/56
Adding vacuum capacity	1,000	5/56
Building Platformer	3,000	5/56
International Refineries, Inc., Wrenshall, Minn.:		
Building Powerforming unit	2,800	8/56
L		
Leonard Refineries, Inc. (Leonard Division), Alma, Mich.:		
Adding crude capacity	3,500	9/56
M		
Magnolia Petroleum Co., Beaumont, Tex.:		
Adding crude capacity	15,000	1956
Building T.C.C. unit (55% recycle) to replace 11,800-bbl. per day Houdry unit	35,800	1956
Building Sovaforming unit	25,000	Late 1956
Planning Sovafining unit	30,000	Late 1957
Planning HF alkylation unit	8,000	Late 1957
McColl-Frontenac Oil Co., Ltd., Edmonton, Alta., Canada:		
Building Platformer	3,000	1956
McColl-Frontenac Oil Co., Ltd., Montreal East, Que., Canada:		
Building hydrotreating unit	10,000	Late 1956
Midland Cooperatives, Inc., Cushing, Okla.:		
Building Platformer	2,600	6/56
N		
National Cooperative Refinery Association, McPherson, Kans.:		
Building Platformer	5,500	2/56
Building HF alkylation unit	1,550	1/57
North Star Oil, Ltd., Grande, Man., Canada:		
Building new refinery		8/56
Crude capacity	2,500	
Thermal gas oil cracking	1,000	
Sinclair-Baker catalytic reforming	875	
Catalytic hydrodesulfurization	875	
Northwestern Refining Co., St. Paul Park, Minn.:		
Planning catalytic reformer	6,000	1/57
P		
Paragon Oil Co., Tiviton, R. I.:		
Planning refinery	30,000	
Phillips Petroleum Co., Kansas City, Kans.:		
Building Platformer	16,000	7/56
Adding lube capacity	400	9/56
Phillips Petroleum Co., Sweeney, Tex.:		
Adding crude capacity	10,000	11/56
Petroleum Specialties, Inc., Flat Rock, Mich.:		
Adding thermal gas oil cracking	800	1956
Adding thermal naphtha reforming	2,500	1956
Adding Platforming capacity	600	1956
Pontiac Eastern Refining Co., Hattiesburg, Miss.:		
Building new refinery		4/57
Crude unit	11,000	
Fractionation unit for purchased distillates	2,750	
Fluid coking unit	4,800	
T.C.C. catalytic cracking unit (63% recycle)	25,700	
Sulfuric alkylation unit	2,500	
Coke capacity, tons per day	225	
Sulfur recovery unit, tons per day sulfur	20	
Pontiac Refining Corp., Corpus Christi, Tex.:		
Adding crude capacity	5,000	5/56
Building Platforming unit	5,000	5/56
Pure Oil Co., Nederland, Tex.:		
Building Ultraformer	15,000	Mid 1956
Building hydrodesulfurization unit	20,000	Mid 1956
Q		
Queen City Oil & Refining Co., Dickinson, N. D.:		
Adding crude capacity	3,000	Late 1956
Adding vacuum capacity	1,200	Late 1956
Building fluid catalytic cracker	1,200	Late 1956
Building thermal polymerization unit	100	Late 1956
R		
Rado Refining Co., McAllen, Tex.:		
Adding crude capacity	1,500	
Regent Refining (Canada), Ltd., Port Credit, Ont., Canada (formerly Trinidad Leaseholds [Canada], Ltd.):		
Adding crude capacity	6,000	1/57
Adding vacuum capacity	10,000	1/57
Adding visbreaker capacity	3,000	1/57
Building fluid catalytic cracker	7,000	1/57
Building catalytic polymerization unit	620	1/57
Richfield Oil Corp., Watson, Calif.:		
Building Sinclair-Baker catalytic reformer	17,000	Mid 1956
S		
Shamrock Oil & Gas Corp., Sunray, Tex.:		
Building Platformer	4,000	3/56
Shell Oil Co., Norco, La.:		
Building thermal reformer	4,000	4/56
Shell Oil Co., Houston, Tex.:		
Building Platformer	16,000	3/56
Building hydrodesulfurization unit	16,000	3/56
Shell Oil Co. of Canada, Ltd., North Burnaby, B. C., Canada:		
Building Platformer	3,300	Early 1956
Shell Oil Co. of Canada, Ltd., Montreal East, Que., Canada:		
Adding crude capacity	10,000	Mid 1956
Adding vacuum capacity	13,000	1/56
Building Platformer	6,600	Mid 1956
Building hydrodesulfurization unit	7,500	Mid 1956
Sinclair Refining Co., Marcus Hook, Pa.:		
Adding crude capacity	12,000	4/56
Sinclair Refining Co., Houston, Tex.:		
Building Sinclair-Baker reformer	24,000	3/56
Sioux Oil Co., Newcastle, Wyo.:		
Adding crude capacity	500	Early 1956
Building Houdriformer	750	Early 1956
Skelly Oil Co., Denver:		
Building Platformer	650	Spring 1956
Socony Mobil Oil Co., Inc., East St. Louis, Ill.:		
Building Sovaformer	12,000	Early 1957
Building Sovafiner	16,000	Early 1957
Socony Mobil Oil Co., Inc., East Chicago, Ind.:		
Building Sovaformer	9,000	5/56
Building alkylation unit	2,900	5/56
Socony Mobil Oil Co., Inc., Paulsboro, N. J.:		
Building Sovaformer	22,000	4/56
Building catalytic hydrogenation unit	22,000	3/57
Socony Mobil Oil Co., Inc., Trenton, Mich.:		
Building Sovaformer	9,000	4/56
Socony Mobil Oil Co., Inc., Buffalo, N. Y.:		
Building Sovaformer	9,000	7/56
Socony Mobil Oil Co., Inc., Casper, Wyo.:		
Adding thermal gas oil cracking unit	1,500	6/56
Somerset Refinery, Somerset, Ky.:		
Adding Cycloversion catalytic cracking capacity	300	3/56
Southwestern Oil & Refining Co., Corpus Christi, Tex.:		
Catalytic reforming unit under construction	9,000	

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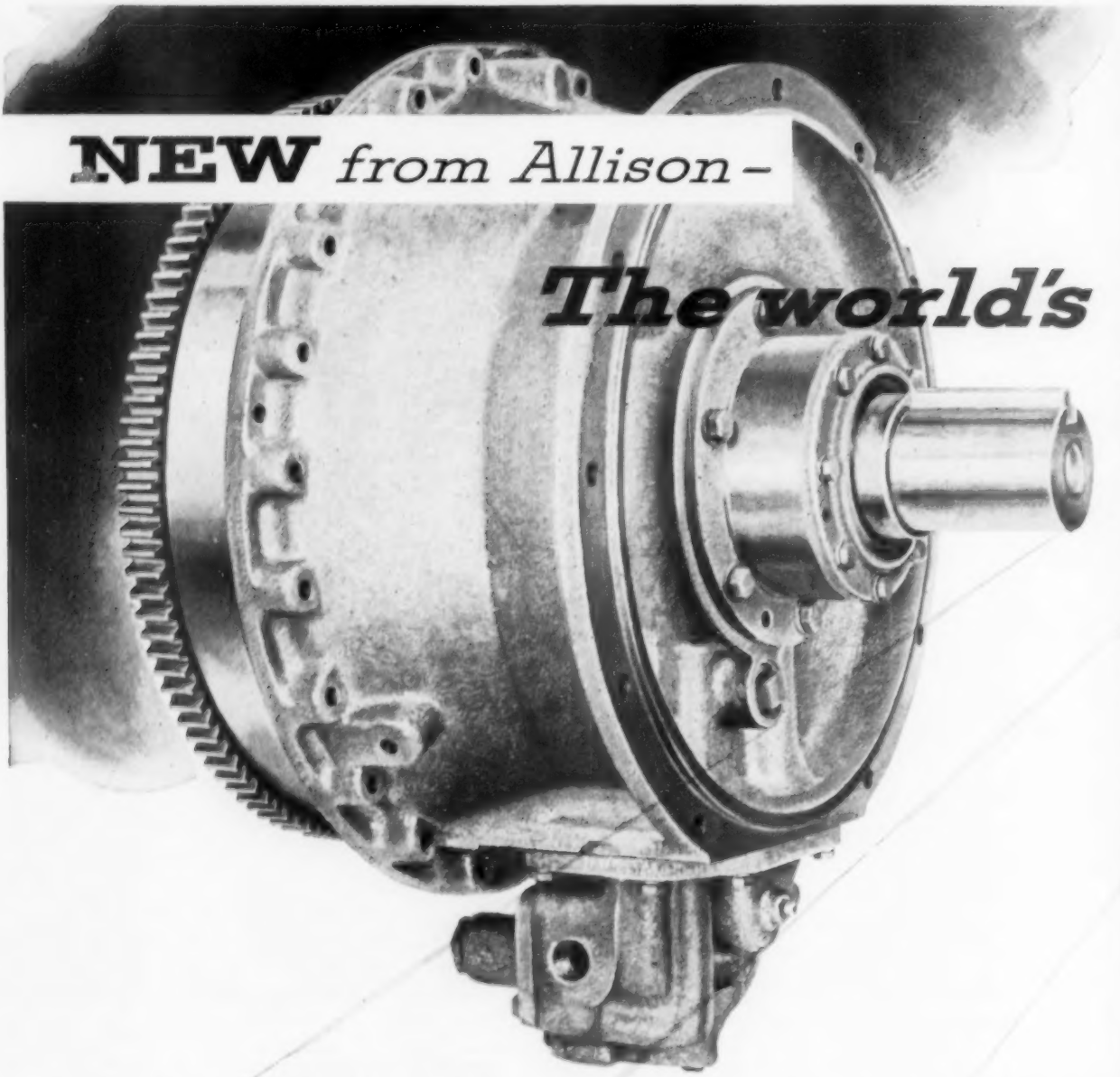
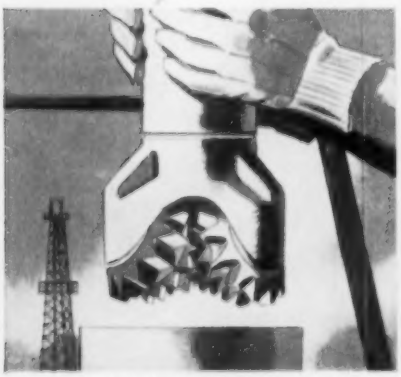
The world's

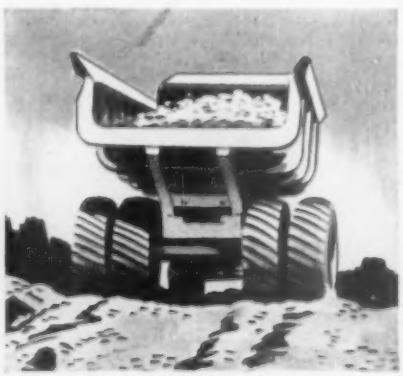


FOR ANY JOB FROM 100 TO 350



Drilling Rigs

Shovel-type Loaders



Off-Highway Trucks

most versatile TORQUE CONVERTER

Now, from Allison, comes the world's most versatile torque converter—the Series 500 TORQMATIC—to give you more power over a wider working range and permit you to standardize on *one* type of converter for *all* your equipment.

In *one standard housing* it gives you a choice of 4 ranges, 7 torque ratios, 100 to 350 horsepower coverage.

It's available for practically any application—automotive, industrial or a combination of both.

And it's designed for rough, tough service in scores of fields—construction, mining, oil drilling, logging, materials handling—wherever gasoline or Diesel engines are used.

This new Series 500 TORQMATIC Converter embodies every engineering advance developed by Allison in building tens of thousands of TORQMATIC Converters over the past seven years.

In many applications it will permit the use of lower horsepower engines with no reduction in *working* power because it multiplies engine torque (true measure of an engine's *working* ability) from 250% to 360%.

And the new Series 500 TORQMATIC Converter will also permit engines to run in their best speed range—transmit more power in the high-speed range.

Soon you will be able to get the TORQMATIC 500 in scrapers, off-highway trucks, log loaders, drilling and servicing rigs, shovels, cranes, graders, industrial locomotives, ditchers and shovel-type loaders made by a score or more manufacturers.

For the names of these manufacturers and full details on the TORQMATIC *Series 500 Converter write to:*

Allison Division of General Motors
Box 894R, Indianapolis 6, Indiana

HORSEPOWER GM TORQMATIC *Allison* TORQMATIC DRIVES

Graders

Cranes

Shovels

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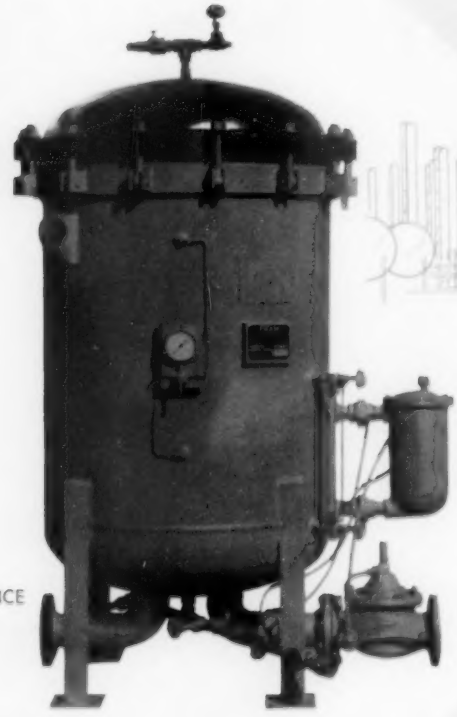
NEW VERTICAL SEPARATOR / FILTER



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- OPERATES ON LIQUID FUELS (JP-3, JP-4, JP-5, AVIATION GASOLINE, KEROSENE, DIESEL FUEL, NO. 2 FUEL OIL, SOLVENTS, AROMATICS, ETC.)
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DIVISION OF FRAM CORPORATION

REPRESENTATIVES IN MAJOR CITIES

WRITE FOR BULLETIN WL-5-56

Company, location of refinery, and type of project—	Capacity or prod. rating (bbl. per stream day)	Completion schedule
Standard Oil Co. (Ind.), Whiting, Ind.:		
Building crude unit (will replace some marginal capacity)	60,000	Early 1956
Adding vacuum capacity	22,800	Early 1956
Building Ultraformer	14,000	Mid 1956
Adding lube capacity	800	Mid 1956
Standard Oil Co. (Ind.), Sugar Creek, Mo.:		
Building sulfuric alkylation unit	3,800	Early 1957
Standard Oil Co. (Ind.), Mandan, N. D.:		
Building Ultraforming unit	6,000	Mid 1956
Standard Oil Co. (Ind.), Casper, Wyo.:		
Adding lube capacity	380	1957
Vacuum unit	4,800	
Propane deasphalting unit	1,000	
Furfural extraction unit	1,500	
MEK dewaxing and deoiling unit	2,000	
Standard Oil Co. (Ohio), Cleveland:		
Building Ultraformer	10,000	5/56
Standard Oil Co. of Texas, El Paso, Tex.:		
Adding crude capacity	23,000	
Sunset Oil Co., Torrance, Calif.:		
Adding visbreaker capacity	300	2/57
Sunshine State Refineries, Inc., Plant City, Fla.:		
Planning new refinery	10,000	
Suntide Refining Co., Corpus Christi, Tex.:		
Adding crude capacity	13,000	6/56
Adding vacuum capacity	3,000	6/56
Adding fluid catalytic cracking capacity (30% recycle)	5,000	6/56
Adding HF alkylate capacity	500	
Adding polymerization capacity:		
Gasoline	25	
Tetramer	50	
T		
Texas Asphalt & Refining Co., Pasadena, Tex.:		
Planning new refinery	2,500	
The Texas Co., Wilmington, Calif.:		
Adding fluid catalytic cracking capacity	5,000	7/56
Building furfural refining unit	25,000	2nd qtr. 56
Building butane deasphalter	13,000	2nd qtr. 56
The Texas Co., Lawrenceville, Ill.:		
Adding crude capacity	5,000	7/56
Adding fluid catalytic cracking capacity	2,000	4th qtr. 56
Adding vacuum capacity	8,500	4th qtr. 56
The Texas Co., Lockport, Ill.:		
Adding alkylation capacity	1,000	1st qtr. 56
The Texas Co., Westville, N. J.:		
Adding crude capacity	6,000	7/56
Adding fluid catalytic cracking capacity	6,500	4th qtr. 56
Adding vacuum capacity	10,000	4th qtr. 56
Adding visbreaker	13,330	4th qtr. 56
Building hydrotreating unit	6,500	7/56
The Texas Co., Casper, Wyo.:		
Building Platformer (to replace thermal reformer 1,500)	4,000	7/56
Texas Gas Corp., Winnie, Tex.:		
Adding crude capacity	7,500	7/56
Tide Water Associated Oil Co., Associated, Calif.:		
Building fluid coking unit	42,000	1956
Building fluid catalytic cracker (0% recycle)	47,500	1956
Building hydrodesulfurization unit	24,000	1956
Tide Water Associated Oil Co., Delaware City, Del.:		
Building new refinery		4th qtr. 56
Crude capacity	130,000	
Fluid catalytic cracking	102,000	
Fluid coking	42,000	
Houdriforming	45,000	
Catalytic desulfurization		
Catalytic polymerization		
Sulfur recovery		
U		
Union Oil Co. of California, Arroyo Grande, Calif.:		
Adding crude capacity	5,000	4/56
Adding delayed coking capacity	3,800	4/56
Adding coke capacity	170	
United Refining Co., Warren, Pa.:		
Building catalytic polymerization unit	225	12/56
Building fluid catalytic cracking unit (37.5% recycle)	4,000	12/56
U. S. Oil & Refining Co., Tacoma, Wash.:		
Building new refinery		12/56
Combination crude atmos., vacuum and thermal cracking unit	6,000-10,000	
Catalytic reformer		
Unifining unit		
Propylene polymerization unit		
Utah Oil Refining Co., Salt Lake City, Utah:		
Building Ultraformer	5,500	5/56
V		
Vickers Petroleum Co., Inc., Potwin, Kans.:		
Adding crude capacity	16,800	6/56
Adding vacuum crude capacity	500	6/56
Planning catalytic cracking unit (20% recycle)	8,700	6/56
Planning catalytic reforming unit		
Investigating more thermal cracking capacity		
W		
West Branch Refineries, Inc., West Branch, Mich.:		
Adding crude capacity	5,000	9/56
Adding asphalt capacity	750	
Westland Oil Co., Williston, N. D. (formerly Williston Basin Refining Corp.):		
Adding crude capacity	500	7/56
Building gas oil thermal cracking unit	1,200	7/56
Adding Platformer capacity	600	9/56
Western States Refining Co., North Salt Lake, Utah:		
Building Houdriformer	1,000	
Wilshire Oil Co., Inc., Norwalk, Calif. (now Malco Refineries, Inc.):		
Adding crude capacity	25,000	1/57
Adding vacuum capacity	15,000	1/57
Building fluid catalytic cracker	9,500	1/57
Building Platformer	14,000	1/57
Building Unifining unit	11,000	1/57
Building asphalt straightrun unit	3,200	1/57
X		
X-L Refineries, Ltd., Dawson Creek, B. C., Canada:		
Building new refinery		3/56
Crude capacity	3,200	
Gas oil thermal cracking	1,000	
Houdriforming unit	500	

Shutdown Plants in United States Since Last Journal Survey

Company and plant location—	Cap., bbl. per stream day
California:	
Eureka Refining Corp., Long Beach	4,000 est.
McAllen Refining Co., Huntington Beach	5,000 est.
Kentucky:	
Ashland Oil & Refining Co., Louisville (being converted to petrochemicals)	11,000
Oklahoma:	
Johnson Oil Refining Co., Cleveland (to close 3-30-56)	6,500
Wyoming:	
Continental Oil Co., Glenrock (closed 1-6-56)	4,100

Summary of Refineries in Mexico

(Capacity, bbl. per stream day)

	No. of plants	Crude oil	Cracking
Distrito Federal	1	100,000	22,000
Guanajuato	1	30,000	5,000
Tamaulipas	5	129,500	12,500
Veracruz	1	50,000	4,800
Total	8	309,500	44,300

SHELL Launches New Safety Series

All over the country people are seeing Shell Better Driving Quizzes like the one on the right and those below.

Behind this new campaign lies Shell's conviction that part of our job—as a major supplier of gasoline and oil products—is to promote driving safety. That's why Shell started the famous "Share-the-Road" club back in the late 1930's. That's why we established the Carol Lane Awards for women's efforts toward traffic safety.

This new safety series urges the reader to test his reflexes, eyesight, knowledge of road signs, driving attitudes. No longer can the reader shrug off a safety message as written for "the other fellow." First indications are that these advertisements actually are helping many drivers think more seriously of their highway habits. That's a sure sign of a better future for all of us.

Can you tell a road sign by its shape?
Read and obey your signs of life!
SHELL OIL COMPANY
How far from the car in front should you be at 50 mph?
SHELL OIL COMPANY
See how fast you can move to the brake!
BRAKE
GAS
SHELL OIL COMPANY
Check your driving attitudes
SHELL OIL COMPANY

4

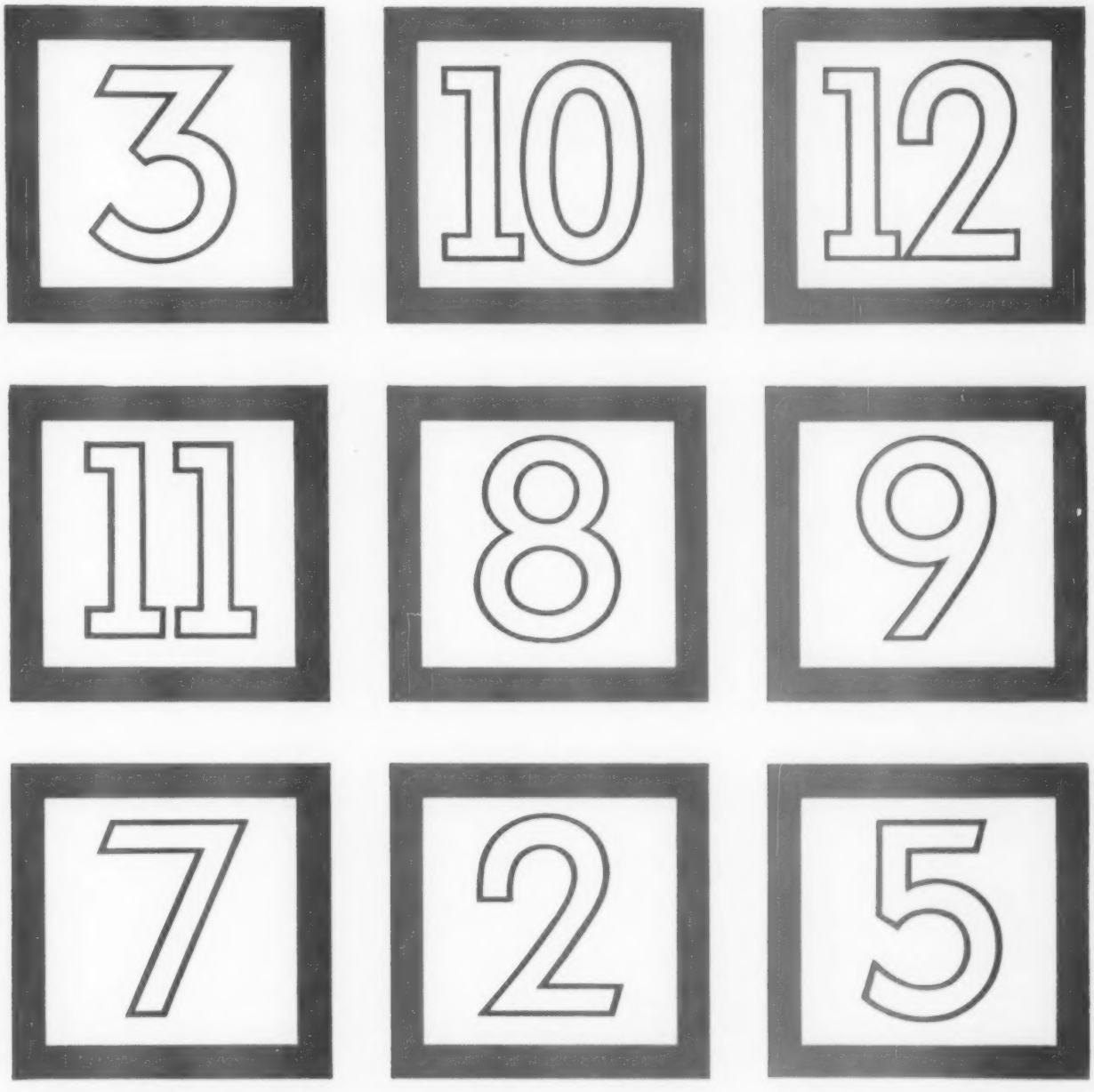
6

1

TRY THIS BETTER DRIVING QUIZ!

It helps you relate your reaction time to safe driving speeds. Others in Shell's public service series on driving safety highlight such factors as courteous attitudes and recognition of road signs.

SHELL



HOW FAST CAN YOU TOUCH EACH SQUARE IN NUMERICAL ORDER?

WITHIN 9 SECONDS? Your reflexes are about average.
WITHIN 7 SECONDS? Very good.
WITHIN 5 SECONDS? Excellent.

MORE THAN 9 SECONDS? YOUR REFLEXES ARE TOO SLOW. DON'T DRIVE OVER 45 M.P.H.*

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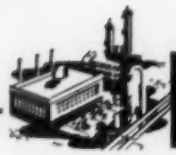
*Authority Dr. Herbert J. Stack, Director, Center for Safety Education, New York University

Material supplied by Worthington Corp.



THE FOREMAN'S PAGE

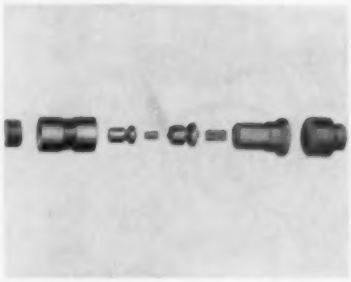
Refining • Petrochem • Natural Gasoline

JOB IMPROVEMENT FOR THE PROCESS FOREMAN—46

How to Install and Maintain Power Pumps—6

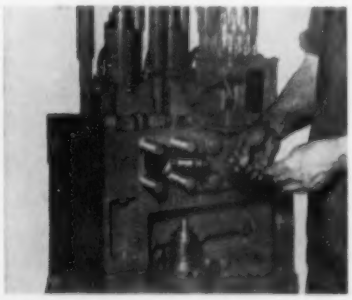
THIS series of articles began in the issue of February 13, 1956. Subsequent installments were published in the issues of February 20, February 27, March 5, and March 12. The final installment will be published in the next issue, March 27.

All of the photos and cutline ideas used in this series are adapted from a special training film made by Worthington Corp. for industry use. It will present the steps involved in putting double-ported valve assemblies back in the pump and checking for proper installation.



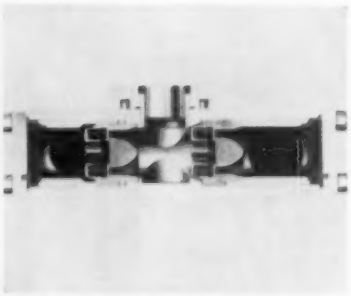
46 In principle, a skirt valve works like a wing valve. The seats are practically the same.

47 However, pumps taking skirt valves usually have access holes behind the valve seats.

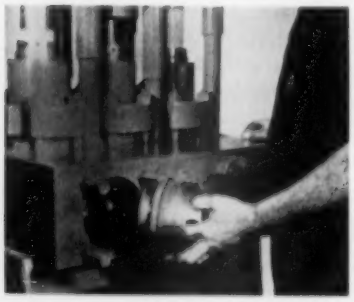


48 When reinserting skirt valves in a horizontal bore, use a rod screwed into the top of the valve.

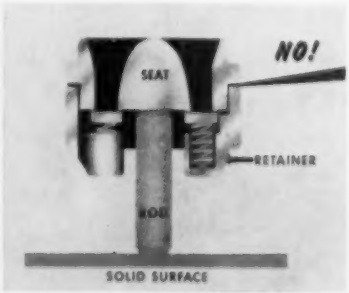
49 Here's another type—the ring or double-ported valve. These are for new higher-speed power pumps.



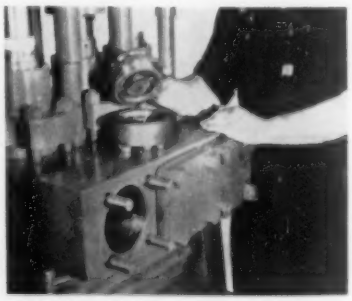
50 These new valves look like this installed. The valve assembly comes out of the pump in one unit.



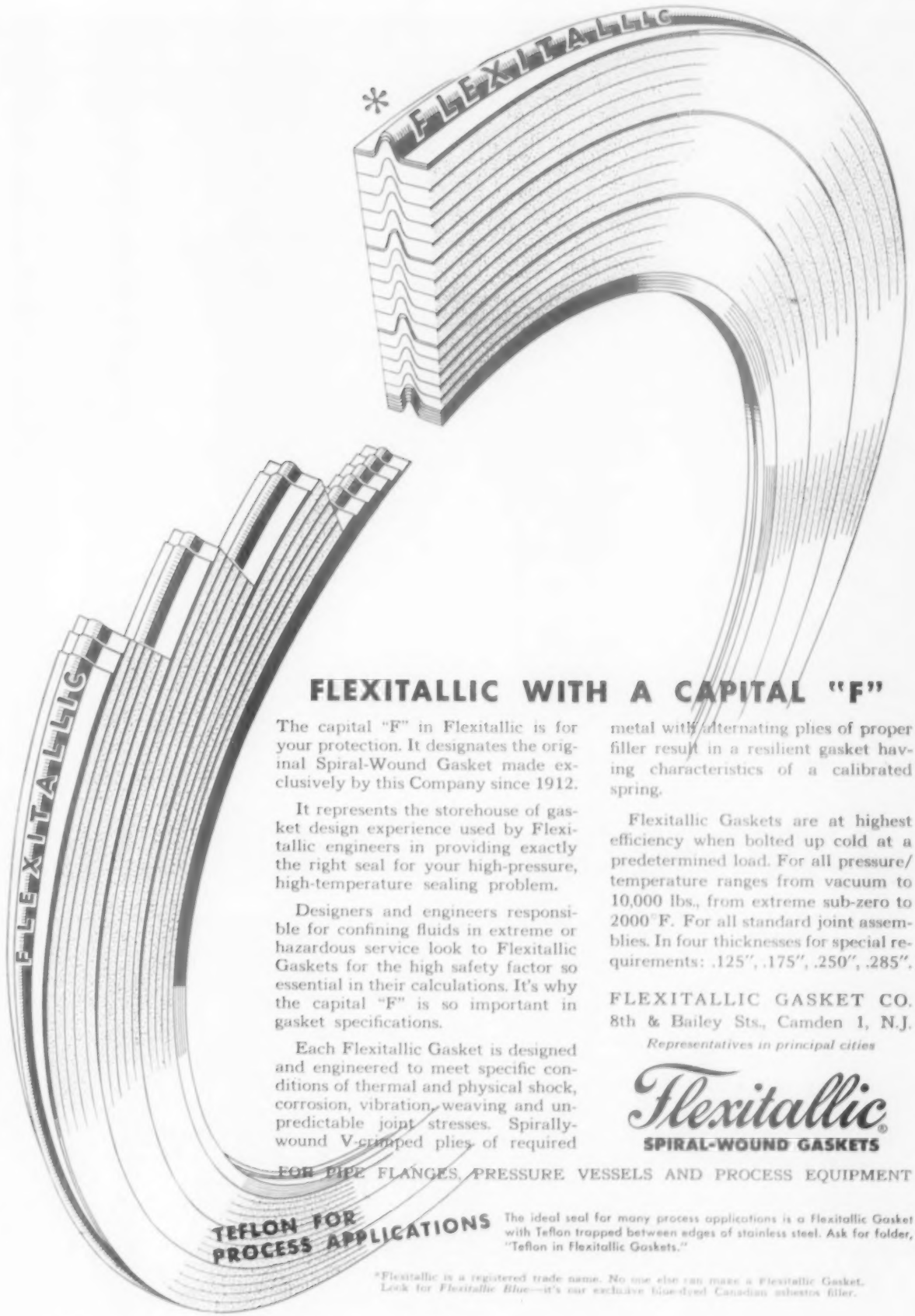
51 The assembly should come out easily after the valve cover is unbolted and the loose plug removed.



52 The seat and spring retainer can be separated on a bench to get at the valve disk and springs.



53 When reassembling, keep the valve disk centered so it is not chewed by the guides in the spring retainer.



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The capital "F" in Flexitallic is for your protection. It designates the original Spiral-Wound Gasket made exclusively by this Company since 1912.

It represents the storehouse of gasket design experience used by Flexitallic engineers in providing exactly the right seal for your high-pressure, high-temperature sealing problem.

Designers and engineers responsible for confining fluids in extreme or hazardous service look to Flexitallic Gaskets for the high safety factor so essential in their calculations. It's why the capital "F" is so important in gasket specifications.

Each Flexitallic Gasket is designed and engineered to meet specific conditions of thermal and physical shock, corrosion, vibration, weaving and unpredictable joint stresses. Spirally-wound V-crimped plies of required metal with alternating plies of proper filler result in a resilient gasket having characteristics of a calibrated spring.

Flexitallic Gaskets are at highest efficiency when bolted up cold at a predetermined load. For all pressure/temperature ranges from vacuum to 10,000 lbs., from extreme sub-zero to 2000°F. For all standard joint assemblies. In four thicknesses for special requirements: .125", .175", .250", .285".

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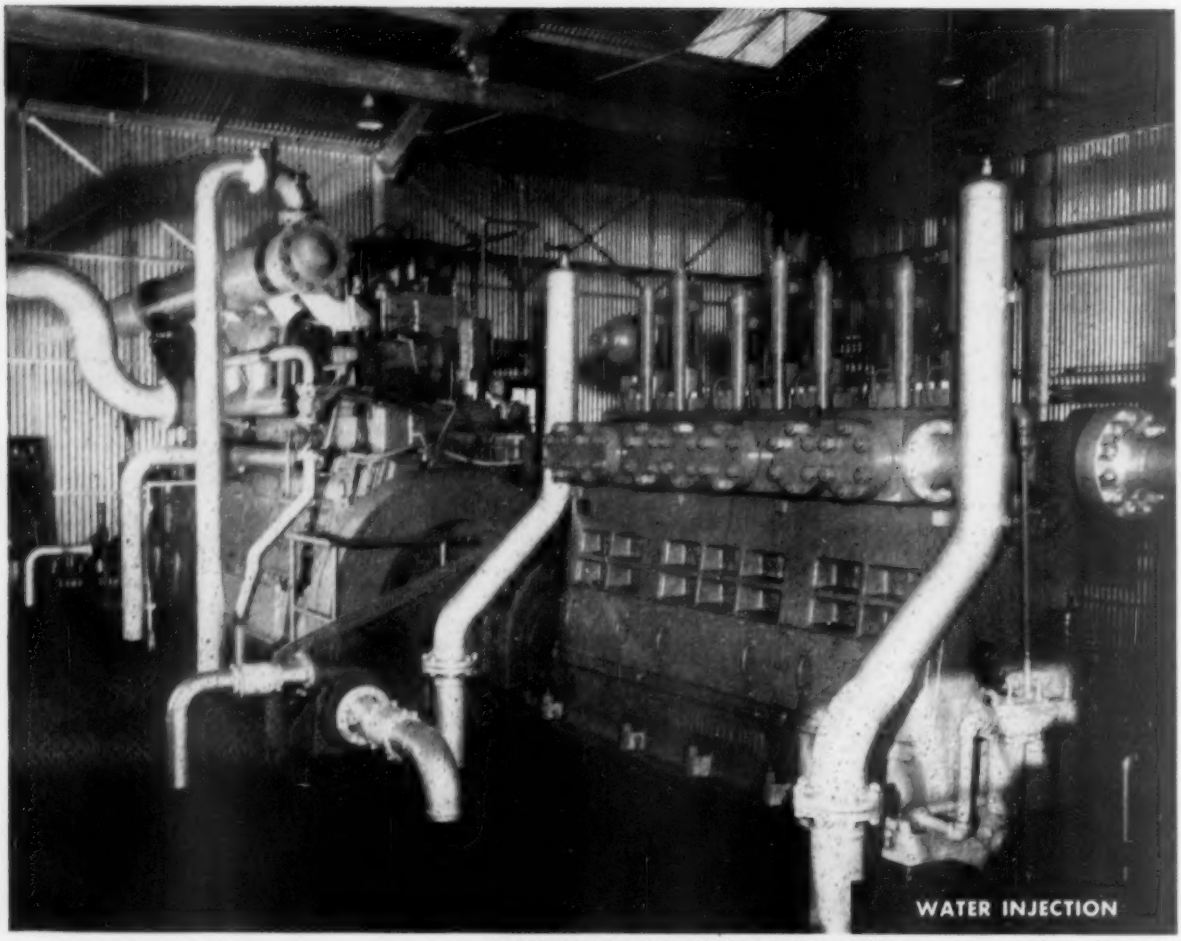
SPIRAL-WOUND GASKETS
FOR PIPE FLANGES, PRESSURE VESSELS AND PROCESS EQUIPMENT

TEFLON FOR PROCESS APPLICATIONS

The ideal seal for many process applications is a Flexitallic Gasket with Teflon trapped between edges of stainless steel. Ask for folder, "Teflon in Flexitallic Gaskets."

*Flexitallic is a registered trade name. No one else can make a Flexitallic Gasket. Look for *Flexitallic Blue*—it's our exclusive blue-dyed Canadian asbestos filler.

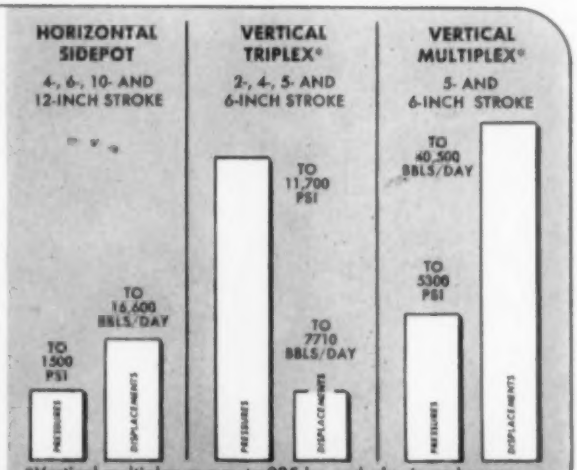


WORTHINGTON MULTI-PLUNGER POWER PUMPS on recovery project using water injection at Warren Petroleum Corporation operated Sharon Ridge Canyon Unit, Scurry County, Texas. Each pump is driven by a Worthington gas engine.

From wellhead to refinery...

Standardization speeds pump selection, delivery, and service for application on...

- ☐ WATERFLOODING
- ☐ SALT WATER DISPOSAL
- ☐ GATHERING
- ☐ PRODUCT PIPELINE
- ☐ LPG STORAGE
- ☐ PROCESS CHARGE
- ☐ RECYCLING
- ☐ FLUID POWER FOR SUBSURFACE PUMPING
- ☐ GAS DEHYDRATION OR DESULFURIZING



*Vertical multiplex pumps to 235 hp and aluminum bronze triplex pumps are stocked for immediate shipment.

VERTICAL POWER PUMP on waterflood service in Copan, Oklahoma can be simply, efficiently, dependably driven by gear motor direct-coupled to crankshaft through flexible coupling or by Multi-V-Drive *(shown)*. These vertical pumps are also suited for product pipeline service.

HORIZONTAL POWER PUMPS ON LPG underground storage service in Regan County, Texas. These power pumps are specially designed to handle volatile liquids with extra deep stuffing boxes. Vertical pumps for higher pressures incorporate straight-through fluid flow and close-clearance liquid ends.

OIL FIELD GATHERING SERVICE in Fort Bend County, Texas is the job of these horizontal power pumps. Running gear is enclosed in oil-tight casing, lubricated by built-in oil distributor. Liquid end features eight accessible sidepot valves.

HORIZONTAL POWER PUMPS in products pipeline installation at San Joaquin Valley, California. These pumps are also excellent for transfer service, salt water disposal and refinery cold-oil and process charge service.

there's a standard power pump for every job!

Because Worthington power pumps are complete-line standardized products, you can expect fast delivery of basic units or parts from local warehouse or works stock; uniform high quality in parts, engineering and service; and a pump exactly suited to your service. These pumps offer such features as:

Reliability—Sound engineering, conservative ratings, rigid inspection and closely controlled running tests on every pump insure consistent, dependable performance.

Easy maintenance—Maximum accessibility of all parts for inspection and maintenance. All valves are separately accessible under individual covers.

Quick-change pump capacity—Interchangeable plunger sizes and stuffing box barrels on vertical pumps permit fast change of pump capacity in field. Interchangeable liners and pistons perform same function on horizontal pump.

Efficient volatile fluid handling—Close-clearance liquid end makes vertical pumps suitable for high-pressure applications where compressibility of liquid is a factor and high volumetric efficiency is required.

See new full-color sound strip film "How To Install and Care for Power Pumps." Write on company letterhead indicating whether you want: (1) salesman to call at company with film and projector; (2) film on loan (if you have 35-mm projector and 33⅓ rpm record player); (3) bulletin G-2198 containing frames from film. Worthington Corporation, Section P.5.4, Harrison, N. J.

P5.4

AIR COMPRESSORS
PUMPS

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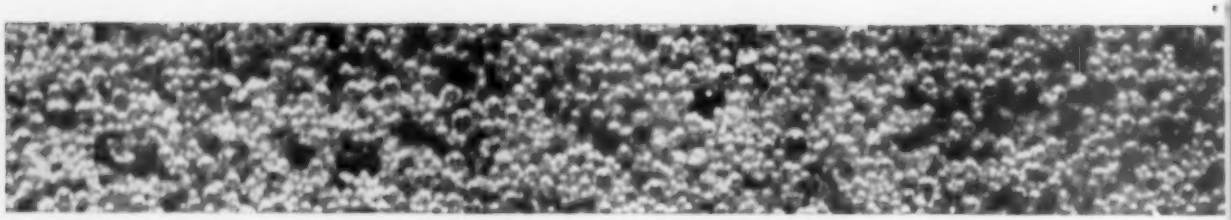
ALLSPEED DRIVE

The half-inch layer that saves 850 barrels



MICROBALLOON* spheres, shown enlarged 60 times, can cut crude oil evaporation as much as 90 per cent—850 barrels a year—in an 88-foot cone-roofed tank.

These spheres are non-abrading and will not harm pumping equipment or pipe lines. Because of the chemical resistance of the phenolic resin, the spheres are not affected by the hydrocarbons in the vapor. For information, write Bakelite Company, or *Chicago Bridge & Iron Company, Chicago 4, Ill.*

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How to Size Relief-Valve Discharge Headers—2

by Nicholas Steshko

PART 1 dealt with factors involved in sizing discharge headers, relief-valve characteristics, and governing codes. Methods of calculation are reviewed in this part.

Which Method of Calculation?

Steps in calculation are: (1) establish the maximum required carrying capacity and the maximum allowable pressure drop of the system; and (2) make the pressure-drop calculation.

If the system is carrying a compressible fluid and the pressure drop in the system is small, the density of the fluid remains nearly constant. So any standard friction-loss equation such as Fanning can be used to calculate the system pressure drop. But if the pressure drop is large, the density varies markedly as the pressure changes, and a kinetic-energy change takes place. The standard friction-loss equations do not take this kinetic-energy change into account. Consequently, the direct use of these equations gives low results.

One common method of approach is the use of the average density in the friction-loss equations. While this method does take into account the changing line pressures, results of this method of approach are still poor. In fact, the magnitude of error can be as high as 25 to 30 per cent, as shown in the paper by Chesler and Jesser.[2]

A basic pressure-drop formula for flow of compressible fluids must be used to achieve correct results. The engineer is faced with the problem of determining the flow condition in this particular case—adiabatic or isothermal. (References for methods of calculation will appear in Part 3.)

Both Lapple[1] and Chesler and Jesser[2] agree that the isothermal and adiabatic solutions give results that are of the same order of magnitude. The difference between the two methods of solution is greatest for short lines, and the difference becomes negligible as header lengths increase. At 1,000 pipe diameters, the results are practically the same.

Author is instrument engineer, process division, Fluor Corp. at Los Angeles. From I.S.A. paper given at Los Angeles meeting.

My own preference of solutions falls to the isothermal solution as developed by Lobo et al.[3] and by Conison.[5] I have found that both lend themselves to design problems and that the Lobo et al. method of solution is being considered for use by the A.P.I. as a method of calculation.

Unfortunately, in most of the isothermal and the adiabatic solutions, the flow conditions used are based on the inlet conditions—which are not always known. When this is the case, the engineer can be forced into a trial-and-error procedure.

The Conison method of solution, however, utilizes the outlet conditions which are known or can be easily calculated by the Crocker[6] formula for critical pressure. From this point, a solution is reached which gives the designer the actual header-inlet pressure, and consequently, the pressure loss in the header.

Conison Equations

The Conison solution is an algebraic solution using all variables evaluated at the outlet conditions. The basic equation is shown below:

$$P_1 = \left[\left(\frac{fL\,\rho_2\,V_2^2}{2gd} \right) (2p_2) + p_2^2 + \frac{2V_2^2\,\rho_2\,p_2}{g} \log_e \frac{V_2}{V_1} \right]^{1/2} \quad (1)$$

Rearranging and substituting $1/V_2$ for ρ_2:

$$P_1 = \left[p_2^2 + \frac{V_2^2\,p_2}{gv_2} \left(\frac{fL}{d} + 2 \log_e \frac{V_2}{V_1} \right) \right]^{1/2} \quad (2)$$

In his paper, Conison stated that for lines 200 ft. or more (or for lines where the change in velocity is small), the term $2 \log_e (V_2/V_1)$ can be ignored without any appreciable error. For the sample solution in this paper, this term will be ignored. But I recommend that engineers not familiar with the Conison equation use the term until they check several problems.

Lobo, Friend, and Skaperdas

The isothermal solution of Lobo et al. is an algebraic and graphic solution. The basic equation developed by them is shown below:

$$1 = (P_2/P_1)^2 + \frac{G^2}{gp_1\,\rho_1} \log_e (P_2/P_1)^2 = 2\Delta P_E/P_1 \quad (3)$$

Rearranged:

$$2\Delta P_E/P_1 = 1 - [1 - (C_K \Delta P_E/P_1)]^2 + \frac{G^2}{gp_1\,\rho_1} \log_e [1 - (C_K P_E/P_1)]^2 \quad (4)$$

The curves shown in Fig. 1 (entitled "Kinetic-Energy Correction for

Nomenclature

- A = inside area, pipe ft.²
- C_K = kinetic energy correction factor
- D = inside diameter pipe, in.
- d = inside diameter pipe, ft.
- e = natural logarithmic base, dimensionless = 2.718 . . . .
- f = Fanning friction factor, dimensionless
- G = mass velocity of gas, lb./sec./ft.²
- g = 32.2 ft./sec.²
- k = ratio of specific heats, dimensionless = C_P/C_V
- L = equivalent length of pipe, ft.
- P = absolute pressure, lb./in.²
- p = absolute pressure, lb./ft.²
- R = 1,544 / Molecular weight of gas
- T = absolute temperature, °F., 460
- V = velocity of fluid, ft./sec.
- v = specific volume, ft.³/lb.
- W = lb./hr. flowing fluid
- ρ = density, lb./ft.³

Subscripts:

- 1 = inlet conditions of pipe
- 2 = outlet conditions of pipe
- t = terminal or outlet conditions of pipe (Crocker equation)
- E = (when used with ΔP_E indicates the uncorrected pressure drop based on inlet conditions, in the Lobo, Friend and Skaperdas charts, see Fig. 4)

Pressure Drop for Isothermal Flow of Gases") are based on Equation 4. This curve is not the original curve as designed by Lobo, Friend, and Skaperdas, but a revised curve designed by Friend and Samiloff.[7] The kinetic-energy corrections shown are for various ratios of $\Delta P_E/P_1$ corresponding to the various values of:

$$\frac{G^2}{g\rho_1 \rho_1} = 5.594 \times 10^{-7} \frac{W^2}{D_i^4 P_1 \rho_1} \quad (5)$$

ΔP_E is the friction loss, based on inlet conditions, in the entire length of pipe. C_K is the kinetic-energy correction which is multiplied by ΔP_E to give the corrected pressure drop. $\Delta P = \Delta P_E C_K$.

References will be given in the next and concluding part to appear in an early issue. An example of calculations will be given.

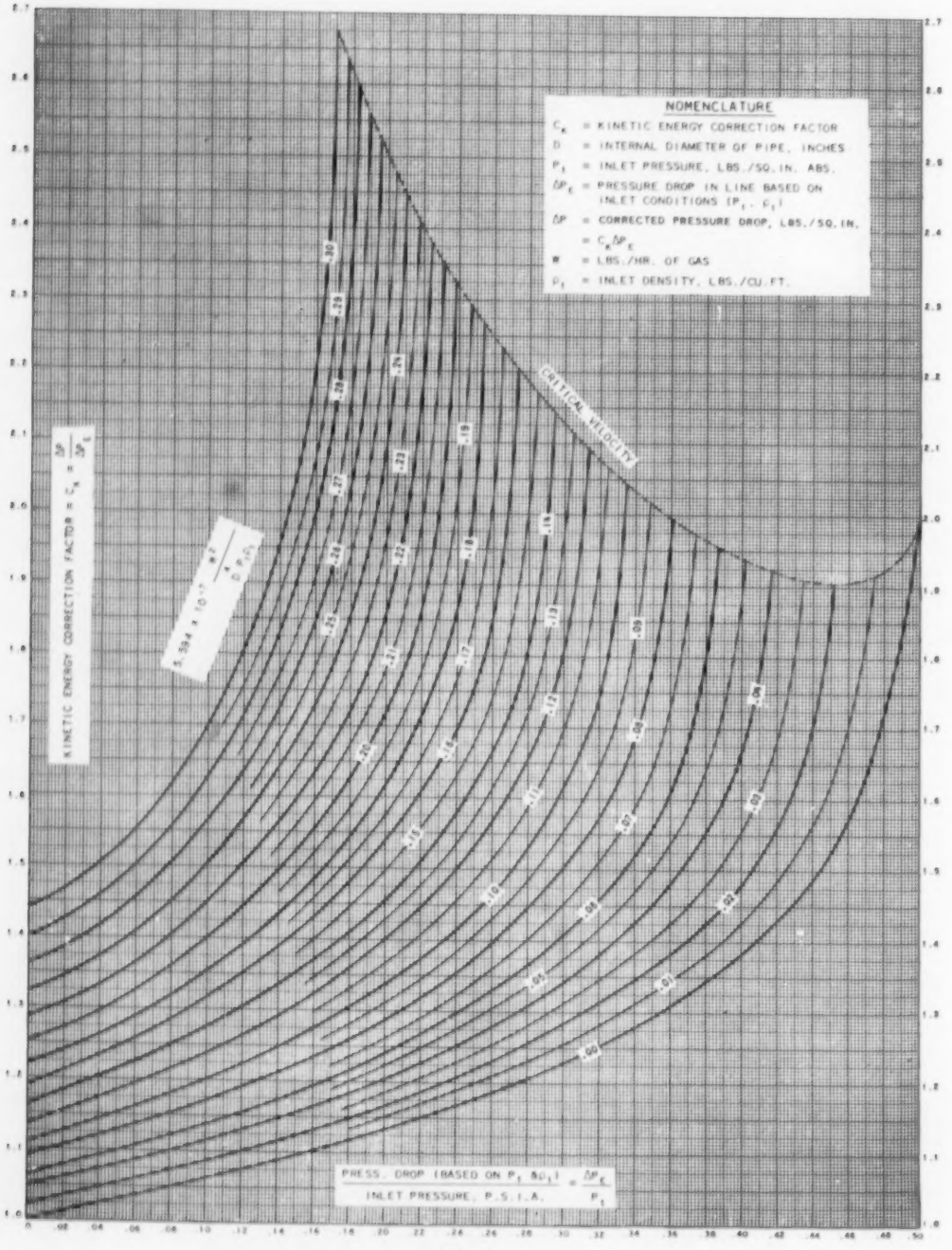
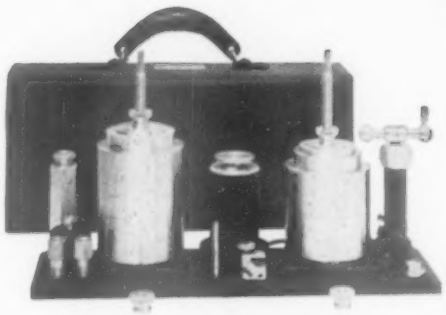

NOMENCLATURE
C_K = KINETIC ENERGY CORRECTION FACTOR
D = INTERNAL DIAMETER OF PIPE, INCHES
P_1 = INLET PRESSURE, LBS./SQ.IN. ABS.
ΔP_E = PRESSURE DROP IN LINE BASED ON INLET CONDITIONS (P_1, ρ_1)
ΔP = CORRECTED PRESSURE DROP, LBS./SQ.IN. = $C_K \Delta P_E$
W = LBS./HR. OF GAS
ρ_1 = INLET DENSITY, LBS./CU.FT.
CRITICAL VELOCITY
KINETIC ENERGY CORRECTION FACTOR = $C_K = \frac{\Delta P}{\Delta P_E}$
$5.594 \times 10^{-7} \frac{W^2}{\frac{\pi^2}{4} D_i^4 P_1 \rho_1}$
PRESS. DROP (BASED ON P_1 & ρ_1) / INLET PRESSURE, P.S.I.A. = $\frac{\Delta P_E}{P_1}$

Fig. 1.

R. S. PORTABLE DEAD WEIGHT TESTER



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It's a point worth remembering next time you need one of the original two-piece sheaves. They're easy to get on, easy to get off, but hold tight on the shaft. Call your local supply store now for the size QD sheaves and V-belts you need.

MV-6.2

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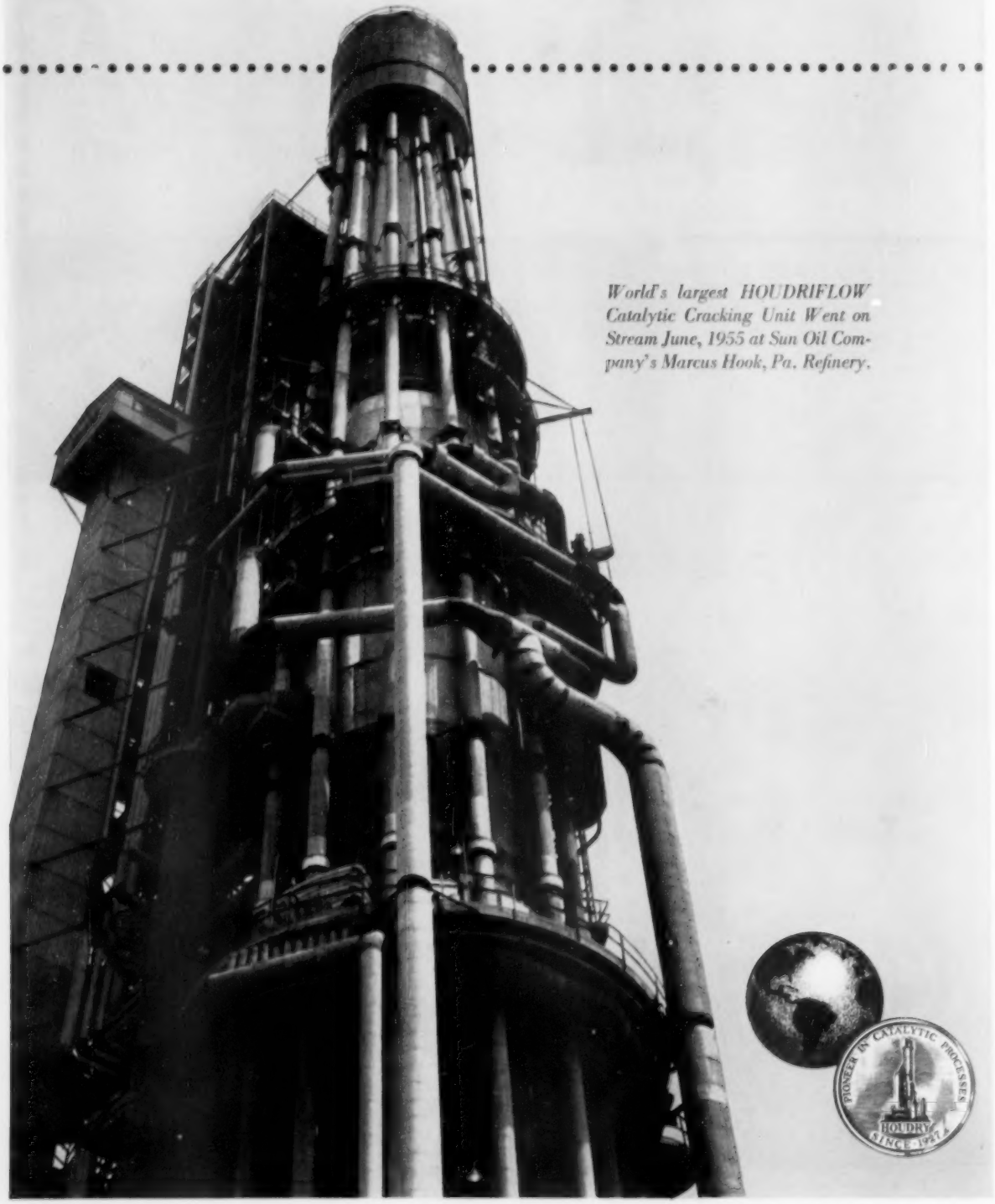
COMPRESSORS • MULTI-V-DRIVES
VARIABLE SPEED DRIVES • PUMPS

Discover for yourself...the inherent



World's largest HOUDRIFLOW Catalytic Cracking Unit Went on Stream June, 1955 at Sun Oil Company's Marcus Hook, Pa. Refinery.

PIONEER IN CATALYTIC PROCESSES
HOUDRY
SINCE 1937

economies of Houdry Processes

20 YEARS AGO—after 13 years of fundamental research—Houdry Process Corporation pioneered the first commercially practicable catalytic cracking unit, as well as the first natural and synthetic cracking catalysts. This resulted in important and far-reaching changes in the petroleum processing industry. Since that time, through continuous research and extensive commercial experience, Houdry has developed other processes and catalysts that offer refiners many inherent economies and better products.

Research, Engineering and Technical Services

Houdry scientists carry on a continuous program of research related to catalysis, processing and equipment. Houdry engineers assist refiners in the planning, operating, maintenance and profitable exploitation of their processing facilities. Subsequent service to licensees may include continuing plant surveys, application of design studies, direct assistance with operating problems and studies of changes in processing schemes required to meet changing needs.

Catalyst Manufacturing

The Chemicals Division of Houdry manufactures synthetic silica-alumina catalysts and a line of extremely hard alumina base catalysts, plus other special types. Houdry's long experience in catalysis permits integration of catalyst performance with specific application requirements. The Chemicals Division also produces pelleted type catalysts to specification, and develops catalysts for special needs.

HOUDRIFLOW Catalytic Cracking Process for the highest product yields at lowest costs

The HOUDRIFLOW Process is outstanding for its high yields of gasoline and high liquid recoveries with accompanying low coke and low dry gas yields. HOUDRIFLOW's simplified design affords flexibility in the choice of operating conditions and types of charging stocks to be processed. The integration of the reactor and kiln into a single vessel makes it necessary to lift the catalyst only once and requires a smaller ground area for the installation of a unit of a given capacity. There are also substantial reductions in initial investment, operating and maintenance costs.

HOUDRESID Catalytic Cracking Process for catalytically cracking the bottom of the petroleum barrel

The HOUDRESID Process eliminates the production of heavy residual fuel by making it practical and economical to catalytically crack the bottom of the petroleum barrel. This refinery-proved, continuous moving bed process converts reduced crudes into exceptional yields of high-octane gasoline and light distillate fuel. The process is well adapted to the use of synthetic or natural clay catalyst, and to the charging of a wide range of reduced crudes.

HOUDRIFORMING Catalytic Reforming Process for maximum yields of aromatics or highest octane fuel

The HOUDRIFORMING Process assures maximum yields of high octane fuel and aromatic concentrates from straight-run naphthas. By utilizing a dual-function catalyst, HOUDRIFORMING provides complete flexibility for producing aromatics or motor gasoline. The process is continuous and non-regenerative. However, for flexibility of operation the catalyst can be regenerated *in place*.

HOUDRY ISO-PLUS Catalytic Reforming Process for reforming low-octane naphthas into 100-octane gasoline

The HOUDRY ISO-PLUS Process reforms run-of-the-refinery, low-octane naphthas into gasolines with octane ratings as high as 108-octane F-1 clear. Conversion rates are extremely high. Variations of the ISO-PLUS Process yield from 86% to 91% of naphtha charge stock into 100-octane gasoline.

HOUDRY DEHYDROGENATION Process for single-step production of butadiene from normal butane

The HOUDRY DEHYDROGENATION Process is the only commercially-proved, single-step process for the production of either butylenes or butadiene from low cost butane. This process is also applicable to the production of propene from propane, isobutene from isobutane, styrene from ethyl benzene, and methyl styrene from isopropyl benzene.

For further information on Houdry processes, services or catalysts, write to Houdry Process Corporation, 1528 Walnut St., Philadelphia 2, Pa.

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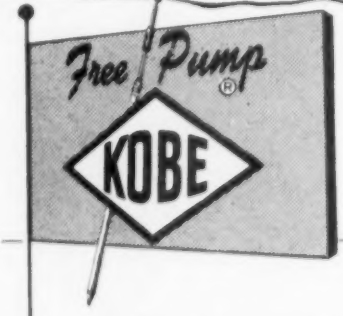
PROCESS CORPORATION
PIONEER IN CATALYTIC PROCESSES

There's a better, easier way to pump oil wells, too...



Tackle an old problem in a new way and frequently you find it tremendously simplified. This is certainly the case with the Kobe *Free Pump* System of oil well pumping... some producers have found it easier to *Free Pump* wells than to flow them. As can be imagined, major economies result. The Kobe system frequently costs $2,000 to $4,000 per well less to install and 50% less to operate. If you are interested in such savings, why not drop us a line?

Our pictorial magazine, Pumping Trends, shows how KOBE is being used to simplify pumping problems everywhere. Write, we'll be happy to add your name to our mailing list.

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Pipeline Patrol

. . . Report on Construction

Under Way, Contracted, and Planned

PIPELINE activity as reported below by The Oil and Gas Journal is compiled from information received from pipeline companies and contracting firms.

These projects include those planned, proposed, under way, and contracted. Uncontracted projects are indicated by ● preceding the job.

Crude-Oil Pipelines

Lakehead Pipe Line Co., Inc.—Company has let 51 miles of 26-in. line to Anderson Brothers Corp., Houston. The job is expected to be completed during the summer of 1956 and is in conjunction with 69 miles of 24 and 26-in. looping that Interprovincial Pipe Line Co. will also complete next summer (see Interprovincial under Canada, also).

● **Offshore Gathering Corp.**—This Houston company has proposed to build a natural-gas and a crude-oil line to gather gas and crude in the Gulf of Mexico off Louisiana. The gas line will be comprised of 60 miles of 24-in., 70 miles of 26-in., and 234 miles of 30-in. The crude line will be mostly 20-in. Each line will be about 364 miles in length. Estimated cost of the lines is $150,000,000.

● **Pasotex Pipe Line Co.**—Firm plans to lay 75 miles of 20-in. along its route from Wink to El Paso, retiring another dual 8-in. section.

● **Shannon Oil Co.**—This Denver firm, along with Farmers Union Central Exchange, Inc., and Mule Creek Oil Co., both of Billings, Mont., plan a 34-mile 6-in. from Murphy Dome in Hot Springs County, Wyoming, to contact Ohio Oil Co. line in Big Horn County. Construction to start in August; end by December 1.

● **Sinclair Pipe Line Co.**—Company will build a 300-mile crude line from Jacksboro, Tex., to Houston. The project will cost $14,000,000 and require 3 years to complete. The 150-mile portion from Jacksboro to Mexia will be 18-in. pipe. The Mexia-Houston portion will be 20-in. River Construction Corp. has Jacksboro to Mexia project.

● **Tecumseh Pipe Line System.**—190 miles of 20-in. to be built by Sinclair Refining Co., Pure Oil Co., Ashland Oil & Refining Co., between East Chicago and Cygnet, Ohio.

● **Union Oil Co. of California.**—Company proposes to build an 815-mile line from Rifle, Colo., to Los Angeles to carry the products from its proposed Rifle, Colo., shale-oil plant to the Los Angeles refining area. The line would cost approximately $56,000,000.

● **U. S. Defense Department.**—Considering a 97-mile, $8,000,000 line from the Elk Hills Naval Reserve in California to the Los Angeles refining area.

● **West Coast Pipeline Co.**—Proposed big-inch crude line from Wink, Tex., to Norwalk, Calif. Company has repeatedly sought federal aid to build line and has been turned down. Plans still in effect however.

Products Pipelines

● **American Pipe Line Co.**—Has received ODM approval to amortize 40 per cent of $178,000,000 with a rapid writeoff on proposed line to run from Gulf Coast area to New York City area.

Cosden Petroleum Corp.—Company is building 100 miles of 6-in. line from its refinery at Big Spring to Abilene, Tex. C. O. Holder Construction Co., of Snyder, Tex., has contract.

● **El Paso Natural Gas Co.**—Firm has disclosed plans to build a 240-mile, "larger than 6-in." line from the Permian basin to El Paso. The line will start in the vicinity of the firm's Midkiff natural-gasoline plant in Midland County, Texas. The new line will carry natural gasoline, butane, and propane.

● **Gulf Refining Co.**—Firm will build a 45-mile, 8-in. products line from Pontiac Eastern Corp.'s planned refinery at Hattiesburg, Miss., to a connection with Plantation Pipe Line Co.'s system. The refinery isn't due on stream until May 1957, and no definite time has been set for start of laying the line.

● **Phillips Chemical Co.**—Firm plans a 50-mile, 4-in. ethylene line from Sweeny, Tex., to Port Adams, Tex. The estimated date of completion is set for October 1, 1956.

● **Phillips Pipe Line Co.**—Firm plans 64-mile, 12-in. products line from Sweeny to Houston. Completion set for April 1956.

Plantation Pipe Line Co.—Firm will spend $23,500,000 in 1956 to expand its system from Baton Rouge, La., to Greensboro, N. C. The company will lay 327 miles of 18-in. from Baton Rouge to just south of Birmingham at Helena, Ala. The new line will increase capacity from 245,000 bbl. daily to 304,000 bbl. Oklahoma Pipe Line Constructors has contract for entire 327 miles. Will start laying pipe about June 1.

● **Sioux Oil Co.**—Firm plans to build 80-mile, 4½-in. line from its Newcastle, Wyo., refinery to Rapid City, S. D. The line is slated for completion in late 1956.

Southern Pacific Pipe Line Corp.—Firm has let an 87-mile, 6-in. products line from its main line at Phoenix to Davis Monathan Air Force Base. Engineers Limited Pipeline Co., of San Francisco has the job. Firm has also let a 76-mile, 6-in. project from near Phoenix to Luke Air Force Base. Hood Construction Co., of Lynwood, Calif., has the job. A 14-mile, 6-in. line from Colton, Calif., to March Air Fore Base will be let later.

● **Sun Pipe Line Co.**—Firm will build 110 miles of 14-in. from Twin Oaks, Pa., to Newark. The line will have a 83,000-bbl. capacity and will replace an existing 8-in. line. September 15, 1956, is expected completion date.

● **Sunflower Pipe Line System.**—Company proposes to build a 215-mile, 6-in. line to transport L.P.G. from six counties in western Kansas to Wichita. Application approved by Kansas Corporation Commission.

● **Tennessee Gas Transmission Co.**—Firm has announced plans for a 200-mile butane line from its natural-gasoline plant west of Corpus Christi, Tex., to the Houston area. The butane will be sold to Petro-Tex Chemical Corp., which operates one of the nation's largest butadiene plants here.

Texas Eastern Transmission Corp.—Company has received Federal Power Commission approval to abandon the "Little Inch" gas line and to convert it to products service. The company will spend $13,000,000 converting the line back to products. When finished the line will have a capacity of 235,000 bbl. daily.

Non-Petroleum Pipelines

American Gilsonite Co.—Company has announced plans for a 100-mile pipeline from near Bonanza, Utah, to a proposed gilsonite refinery in western Colorado. The company, owned by Barber Oil Corp. and Standard Oil Co. of California, plans to make gasoline and coke by refining gilsonite. Gilsonite would be moved in a slurry.

Pittsburgh Consolidation Coal Co.—This firm has announced plans for the first pipeline to move coal. The line will be 108 miles of 10-in. from the company's Georgetown mines in eastern Ohio to Cleveland Electric Illuminating Co.'s Eastlake power plant northeast of Cleveland. Ford, Beacon & Davis, Inc., will issue specifications, let contracts, and supervise the construction work. Williams Brothers has contract and has shut down for the winter. Pipe will start about April 1.

Natural-Gas Pipelines

American Louisiana Pipe Line Co.—Company has let bulk of its 1,121-mile line from North Tepetate, La., to Detroit. Only a 22-in. spur from Payne, Ind., to Bridgman, Mich., is still not awarded. H. C. Price Co., Bartlesville, Okla., has 783 miles of 30-in. pipe. One section will work south from the Hancock-Henry County line and the other will work north from Slaughters, Ky. Brown & Root has 221 miles of 30-in. from North Tepetate to the Louisiana-Arkansas border, and 39 miles of 16-in. line to be built under water. The firm has subcontracted the 221 miles to Associated Pipe Line Contractors and Western Contractors. It will lay the under-water line itself.

● **Arkansas Louisiana Gas Co.**—Firm has announced long-range plans to build a $50,000,000 pipeline from the Texas-Louisiana coastal region to northern Louisiana. The line would connect with the company's present system.

● **Carolina Pipeline Co.**—This newly organized firm has applied to the South Carolina Public Service Commission for permission to distribute natural gas in central South Carolina. The firm plans to build $8,700,000 worth of distribution lines to 14 cities. Other towns in the area without natural-gas service may be included eventually. The new firm plans to buy gas from either Transcontinental Gas Pipeline Co. or Southern Natural Gas Co.

● **Carolina Natural Gas Corp.**—185 miles 8-12-in., proposed lateral lines off Transcontinental in North and South Carolina.

Cascade Natural Gas Co.—Firm has let contract to Engineering Construction Co., of Tulsa, for 400 miles of gas distribution lines in the State of Washington. The lines will range from 3/4 to 12-in. and will be laid in the towns of Yakima, Grandview, Granger, Trosper, Sunnyside, Toppenish, Union Gap, Wahpato, and Zillah. Work will start April 1.

● **Coastal Transmission Corp.**—Has applied to FPC for permit to lay 565 miles of 22 and 26-in. from McAllen, Tex., to Baton Rouge where it would deliver to Houston Texas Gas & Oil Co.'s proposed line to Florida. Coastal also plans 272 miles of smaller gathering lines.

● **Colonial Natural Gas Corp.**—Company proposes to build two systems, one from the Houston-Lake Charles area to Miami, Fla., and the other in the Carolinas and Georgia. Neither idea is before the FPC yet.

● **Colorado Interstate Gas Co.**—Firm completed 136 miles of 22-in. from Laramie, Wyo., to Denver in November. Second part of line from Laramie to Rock Springs, Wyo., will be laid in 1956. The second section will

More than a mere pipe fitting!

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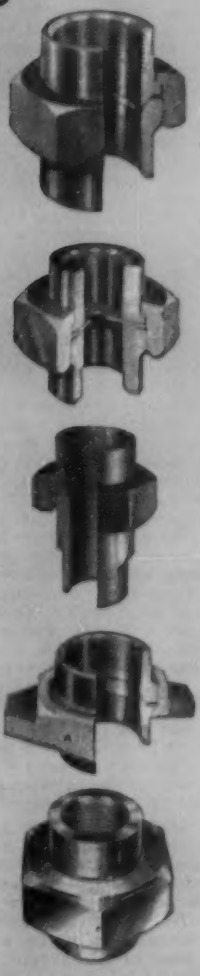

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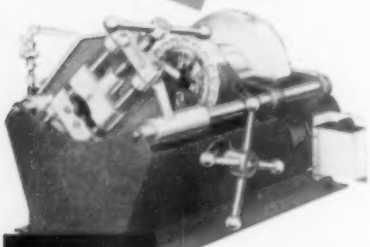

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Pipeline Patrol

be 238 miles of 22-in. pipe and will be completed about October 1.

Company also proposes a 500-mile line from Laramie, Wyo. to Beatrice, Neb. to deliver 350 M.M.c.f.d. to Natural Gas Pipeline Co. of America. Size not disclosed.

• **El Paso Natural Gas Co.**—Firm has received FPC permission to loop 450 miles of 34-in. line from the San Juan basin to the Colorado River at the Arizona-California border.

• **Houston Texas Gas & Oil Co.**—Company has applied to FPC for permission to lay a 960-mile gas line between Baton Rouge and Miami. The main line would consist of 507 miles of 30-in., 157 miles of 26-in., 61 miles of 20-in., 224 miles of 18-in., and 12 miles of 12-in. Company also plans 500 miles of sales laterals in Florida. Main line would join with Coastal Transmission's proposed line from McAllen to Baton Rouge.

• **Iron Ranges Natural Gas Co.**—This St. Paul company has filed an application with the FPC to build a 68-mile transmission line and 47 miles of laterals to supply various towns and cities on the Mesabi Iron Range in Minnesota.

• **Lone Star Gas Co.**—Company has two plans up before FPC to enlarge its system in Texas and Oklahoma. One is for an $18,000,000, 230-mile line from Cotton County, Oklahoma, to Fritch, Tex. The other plan is for a 205-mile line from Snyder, Tex., to a hookup with the Cotton-Fritch line. The company hopes to prevent Natural Gas Pipeline Co. of America from building its line from Wise County, Texas, to Fritch (see below).

• **Michigan Consolidated Gas Co.**—25 miles, 12-in., proposed, from near Sparta to Muskegon, Mich.

• **Michigan Wisconsin Pipe Line Co.**—251 miles, proposed, 24, 18, 12, 6, and 4-in. loops. Majority will be in Wisconsin.

• **Midwestern Gas Transmission Co.**—Company will build a main line from Portland, Tenn., to Canadian border near Emerson, Man., Canada. Extensions from main line to cities in Minnesota and Wisconsin are also planned. The main line will be comprised of 829 miles of 24-in., 109 miles of 16-in., and 174 miles of 12-in. The extensions will total 648 miles of 3 to 18-in. pipe. The application is now pending with the FPC.

• **Natural Gas Pipeline Co. of America.**—Company has FPC examiner's approval to build 350 miles of 20 and 26-in. line from Jack and Wise counties in North Texas to Fritch, Tex., near Borger. Approval and its conditions will be contested by both Natural Gas Pipeline and Lone Star Gas Co.

Company has also proposed 389 miles of 36-in. loop along its line from Beatrice, Neb. to Chicago to take gas from a proposed line of Colorado Interstate Gas Co. In addition, another 91 miles of 30-in. loop would be laid along other parts of Natural's main line.

Nevada Natural Gas Co.—Company plans looping program along its 114-mile line from Needles, Calif., to Las Vegas, Nev. Mileage and size are unknown but cost will be about $2,500,000.

• **North Carolina Natural Gas Corp.**—This subsidiary of Colonial Natural Gas Corp. (formerly Texas-Ohio Gas Co.) has received permission from the North Carolina Utilities Commission to build 575 miles of gas lines in the state. The system will range in size from 3 to 16-in. and will cost about $13,000,000. The line will run from a point on Transcontinental Gas Pipe Line Corp.'s system near Mooresville, eastwardly across North Carolina. It will deliver gas to customers in a territory lying east of Charlotte and south of Lexington, Sanford, and Raleigh.

• **Northern Natural Gas Co.**—Company plans to spend $32,000,000 to add 348 miles of main line and 307 miles of branch lines in Wisconsin, Minnesota, South Dakota, and Iowa. The application is before the FPC now. The main lines include 169 miles in the Duluth-Superior area and 164 miles in the Aberdeen area of South Dakota.

• **Pacific Gas & Electric Co.**—Company's long-range plans call for looping the Topock-Milpitas line with 135 miles of 34-in. The major part of the line will be laid in 1956, while 62 miles will be laid in 1957.

Pacific Northwest Pipe Line Corp.—Over 700 miles of trunk line has been completed and firm has let contracts on remainder of job, 760 miles of trunk and sales laterals. Contractors are:

A. P. V. Co., Inc., 81 miles 26-in. between Plymouth and Goldendale, Wash.

Engineers Limited, Inc., 56 miles 26-in. between Goldendale and Stevenson, Wash.

Midwestern Constructors, Inc., 79 miles 26-in. between Stevenson and Toledo, Wash.

River Construction Corp., 64 miles 26-in. between Toledo and Tacoma; also 16 miles of 18-in. out of Portland, Ore.

B & M Construction Co., 53 miles 26-in. between Tacoma and Duvall, Wash.

Curtis Construction Co., 87 miles 26-in. between Duvall and Sumas, Wash.

Hood Construction Co., 31 miles 6-in. near Walla Walla, Wash.

R. H. Fulton & Co., 156 miles 20 and 16-in. lateral from main line to Spokane; also 129 miles of laterals into Idaho.

Eastern Pipeline Construction Co., 137 miles 10, 8, and 6-in. lateral to Yakima and Wenatchee.

H. B. Zachry Co., San Antonio, has contract for 42 miles of 4 to 16-in. line in the San Juan basin area of New Mexico. Pipe laying began in January.

Portland Gas & Coke Co.—United Engineers & Constructors, Inc., of Philadelphia, has engineering contract for 80 miles of

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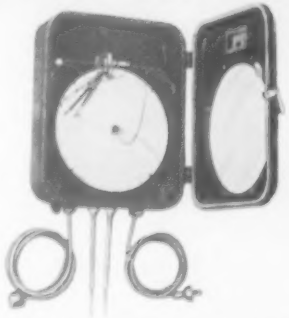
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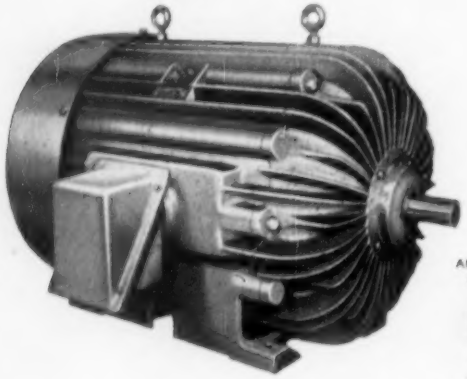

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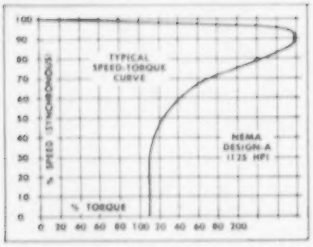

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various size lines up to 16-in. for this Portland, Ore., firm. River Construction Corp. is winding up work on a 16-in. river crossing of the Willamette River for the company.

• **Southern California Gas Co.** and **Southern Counties Gas Co. of California.**—Firms have plans for three separate jobs. First is 19 miles of 30-in. from Placentia to Compton, Calif. Completion set for November 1956. Second job is 70 miles of 30-in. from Palmdale to Alhambra, Calif., and completion is slated for November, too. Third job is 210 miles of 30-in. from Topock to Palmdale. Last job not expected to be finished before April 1957.

• **Southern Natural Gas Co.**—Company has temporary FPC authority to build 39 miles of loop lines and add 4,950 hp. to its compressor power near Atlanta, Ga. Job will cost about $2,000,000.

Tennessee Gas Transmission Co.—The firm has the following projects under way or planned.

Project 1—147 miles of 26-in. and 74 miles of 30-in. Thirty runs from Cave City, Ky., to Danville, Ky. Twenty-six-inch runs from a point north of the Ohio River to McConnellsville, Ohio, and from Newcomerstown, to near Lisbon, Ohio. Approved by FPC but not yet contracted. Completion set for fall of 1956.

Project 2—192 miles of 24-in., 34 miles of 20-in., 15 miles of 18-in., and approximately 110 miles of 4, 6, 8, 10, and 12-in. from point west of Crowley, La., looping the Bayou Sale gathering line for a distance of 74 miles to a point near the mouth of the Mississippi River. Houston Contracting Co. has about 162 miles of this, including 82 miles of 24-in. east of Jeanerette toward Leeville. Job includes 137 miles of marine work. Pipelaying started February 15.

Project 3—63 miles of 30-in. and 99 miles of 26-in. Thirty-inch will run from Scottsville, Ky., to Cave City, Ky., and from point southwest of Danville, Ky., to a point northeast of Danville. Twenty-six-inch will run from near Greenup, Ky., to just north of the Ohio River; from McConnellsville to near Newcomerstown and from Lisbon to Mercer, Pa. Application pending with FPC.

Project 4—Approximately 100 miles of 4, 6, 8, 10, and 12-in. gathering lines in the Gulf Coast area of Texas and Louisiana. Application pending with FPC.

(For news of a Tennessee subsidiary see Midwestern Gas Transmission Co.)

Texas Eastern Transmission Co.—Company has received FPC permission to begin converting its Little Inch line from natural gas to products service.

Company asked the FPC late in December 1955 for permission to build a 422-mile, 30-in. line from McAllen to Beaumont, Tex. The line would be used to transport imported Mexican gas. The firm also asked the FPC for permission to loop 530 miles of its 30-in. line from Kosciusko, Miss., to Uniontown, Pa. The company will also lay 45 miles of 24-in. from Provident City, Tex., to connect in Matagorda County, Texas. This would tie the Wilcox Trend Gathering System in with the extension from Mexico. The company will add 50,000 hp. in new compressor capacity and enlarge existing stations by 20,780 hp.

• **Texas Gas Transmission Corp.**—Company has received authority from a FPC examiner to build a 105-mile supply line extending from East Lake Palourde Gas field in Assumption Parish, Louisiana, to its system in Arkansas, Mississippi, Tennessee, Kentucky, and Indiana. The lines and additional compressor facilities totaling 19,190 hp. will cost about $20,000,000.

• **Trans Carolina Pipe Line Corp.**, Com-

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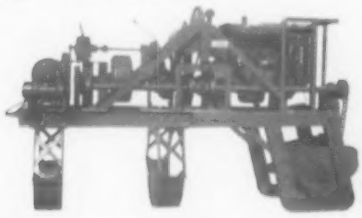

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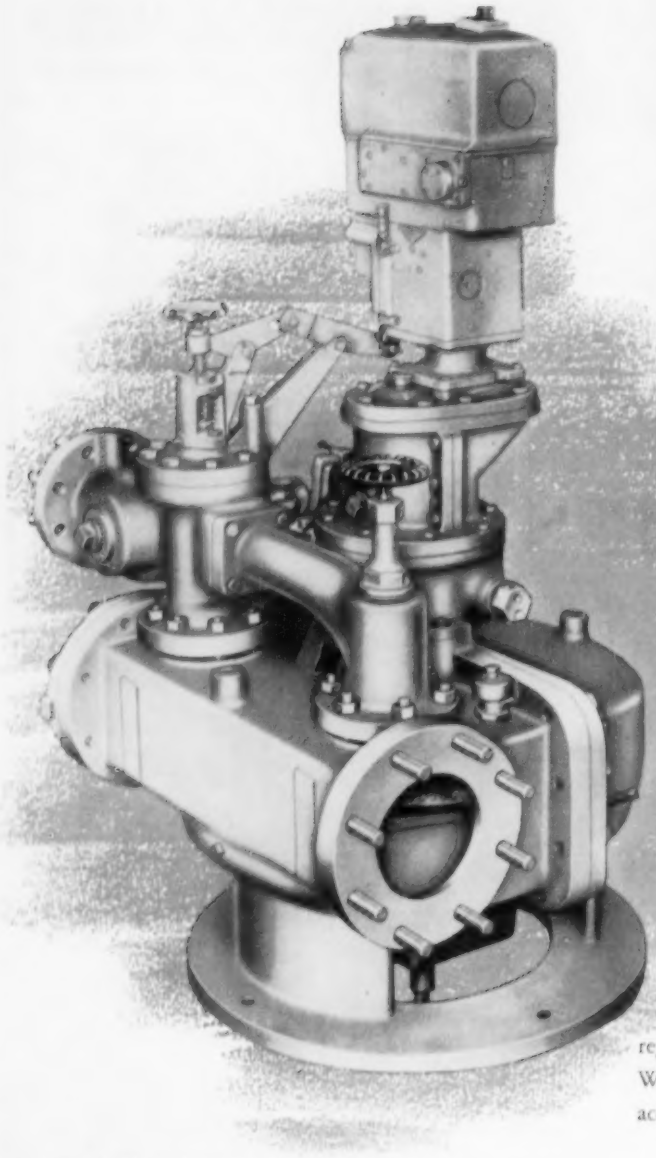

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Pipeline Patrol

mercial Building, Raleigh, N. Car.—Seeks FPC permit for 300-mile system across North and South Carolina, plus 500 miles of laterals.

• **Transcontinental Gas Pipe Line Corp.**—Has applied to FPC to lay 160 miles of 36-in. and 68 miles of 30-in. loops along its Texas to New York line.

Has FPC permit to lay 24 miles of line to gather gas from South Bayou Mallet, Maxie, and Happytown fields of Louisiana at cost of $754,000.

Will also lay 12 miles of 16-in. to gather gas from Live Oak field in Vermilion Parish, Louisiana.

• **Trunkline Gas Co.**—Firm has applied to FPC for authority to build eight new compressor stations and 24 miles of pipeline on its transmission system to enable it to sell additional gas to Panhandle Eastern Pipe Line Co. Total capacity of the new stations would be 56,000 hp. Total cost would be $18,700,000, including $1,000,000 for gathering facilities in the Gulf Coast area. Panhandle filed for 1,600 hp. additional compressor capacity to cost $3,714,000.

• **United Gas Pipe Line Co.**—Firm has received Federal Power Commission authority to construct 105 miles of pipeline in Mississippi, Alabama, Georgia, and Florida. The company will also add 5,300 hp. in compressor capacity. The job will cost about $12,500,000.

• **Utah Natural Gas Co.**—Planning 40 miles from Orem to Salt Lake City, 16-in. pipe at later date. Contract not yet let.

Foreign Crude-Oil Pipelines

Arabian American Oil Co.—Firm is building a 150-mile, 21-in. line from Safaniya field to near the Neutral Zone border.

• **Cremona Pipe Line Co.**—Firm has announced plans for a 60-mile crude-oil line from the Westward Ho-Sundre area to Calgary.

• **Esso, A. G.**—West Germany affiliate of Standard Oil Co. (N.J.) plans line from North Sea port to Rhur-Rhine area. This will probably be 120-mile, 10-in. from Rotterdam to Cologne, the latter rumored as the site of a new 58,000-bbl. refinery to be built by the company.

Ganso Azul Cia de Petroleo.—Company is building a 47-mile, 4-in. line from Agua Caliente field to Pucallpa, a port on the Ucayali River.

• **Gulf Italia Co.**—Firm is laying a 35-mile line from its Ragusa field in southwestern Sicily to a refinery at Augusta operated by RASIOM, an Italian company. The line size was not disclosed. Work is expected to be completed by the end of summer.

Interprovincial Pipe Line Co.—Majestic Contractors, Ltd., has contract for 67 miles of 24-in. and 2 miles of 26-in. along the company's system from Alberta to Sarnia, Ont. The Majestic work will be between Carroll and Somerset, Man., and 2 miles between the U. S. border and the Gretna pumping station. Work will be completed near the end of summer 1956.

• **Iraq Petroleum Co., Ltd.**—Company is making plans to lay a 75-mile, 24-in. products line from Homs, Syria, to Tripoli, Lebanon. The line would have a capacity of 180,000 bbl. daily.

• **Pembina Pipe Lines, Ltd.**—Company has announced proposal to build crude-oil line from Sundre-Westward Ho area of Alberta into Edmonton. Two other companies, Cremona Pipe Line Co. and Rangeland Pipeline Co. also have plans for moving the area's crude.

• **Rangeland Pipe Line Co.**—Subsidiary of Hudson's Bay Oil & Gas Co. has made proposal to build line out of Sundre-Westward

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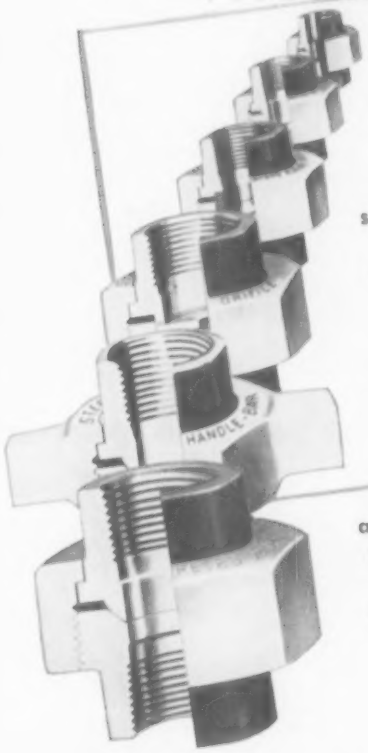

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Pipeline Patrol

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● **Sinclair Oil Corp.**—Company is considering a 240-mile crude-oil line from its San Silvestre field in the state of Barinas, Venezuela, to Puerto Cabello on the Caribbean Sea coast. The line would cost $25,000,000.

● **Standard - Vacuum Oil Co.** — Company has long-range plans for a 90-mile pipeline to give the new Lirik field in Cntral Sumatra an outlet. Completion is not scheduled before 1957 to 1958.

Westspur Pipe Line Co.—Firm has awarded contract to Majestic Contractors, Ltd., Edmonton, for 109 miles of 12-in. line from Midvale, Saskatchewan, to Interprovincial Pipe Line Co.'s pump station at Cromer, Manitoba. West spur has also let contract to same company for 50 miles of various size gathering lines in the Midale-Frobisher area of Saskatchewan.

Foreign Products Pipelines

● **Canadian Hydrocarbons, Ltd., Winnipeg**—Proposes 800-mile LPG line from Edmonton, Alta., to Winnipeg.

● **Chaco Pipeline & Refinery Corp.**—Firm plans to build 450-mile line from Glen McCarthy's wells in Bolivia to a new refinery to be built at Concepcion, Paraguay.

● **Imperial Oil, Ltd.**—Will lay 38 miles of 12-in. loop along present line from Waterdown, Ont., to Toronto.

● **National Fuel Oil Co.**—This company in Israel is a shareholder in a company which plans to build a products line between Haifa and Tel Aviv. The plans call for a 55-mile 6-in. line in which the Government would own 10 per cent.

● **National Iranian Oil Co.** — Company plans $32,300,000, 573-mile, 10-in. products pipeline from Ahwaz to Teheran, Iran. The line will have a capacity of 40,000 bbl. daily. Constain - John Brown, Ltd., London and Williams Brothers Co., Tulsa have southern 337 miles and pipelaying started in February. Entrepose of Paris has the northern 236 miles.

● **North Atlantic Treaty Organization (NATO).**—Laying products lines to airfields in various parts of Europe. About 2,000 miles of line will be laid. Bids were taken in January on 300 miles of 12-in. line between Marseille and Langres, France. Cost will be about $7,850,000.

NATO—Associated Pipeline Contractors, Inc., Houston, is laying 450 miles of products line from Iskenderun, Turkey, to Batman, also in Turkey.

Overland Pipeline Corp.—This South African firm has requested government permission to build a 350-mile line, to cost $8,450,000 from the South African coast to Rand, a plateau area in southern Transvaal where there is heavy petroleum consumption.

The United States Defense Department.—Department is sponsoring a 485-mile, 8, 10, 12-in. products line from Cadiz to Zaragoza, Spain. The contract has been let to Merritt Chapman & Scott; Benson & Montin of Oklahoma City; and Agroman Construction Co., a Spanish firm. Brown-Raymond-Walsh is the prime contractor. Cost of the line will be approximately $5,000,000.

Winnipeg & Central Gas Co.—Canadian company plans to build a $20 million butane-propane system. Company plans to get gas L.P.G. from Signal Oil & Gas Co.'s Tioga, N. D., plant and move it to Winnipeg. Size and route of the line has not been definitely established.

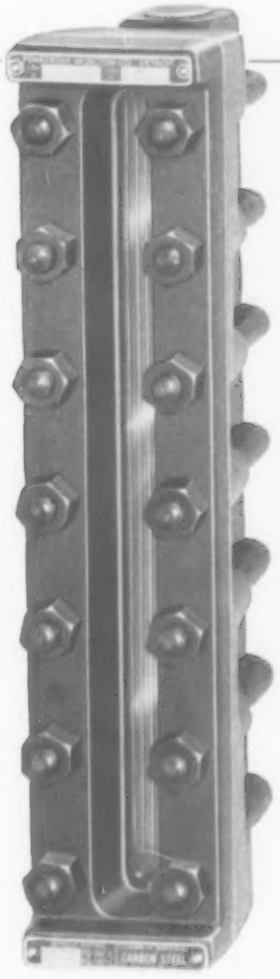
Foreign Natural-Gas Pipelines

● **Alberta Gas Trunk Line Co.**—Company will spend $47,000,000 to build 547 miles of

Where a drop of water

can be fatal . . .

In freezing temperatures at high altitudes, even a trace of water in the gas can cause engine failure. This Filter/Separator successfully removes the last death-dealing drop. It is a product of Bendix-Skinner Division of Royal Oak, Michigan, contractor to the U.S. Navy. Notice that it is equipped with a Penberthy Liquid Level Gage.



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In handling volatile aviation gasoline, two special factors stand out in the selection of gages. They *must* be corrosion-resistant and sparkproof. The Penberthy all-bronze non-magnetic reflex gages used on this installation fill the bill perfectly on both counts. In addition, they offer features found only in Penberthy gages. Features which save time and money on installation and maintenance — provide long, trouble-free service.

So, whether you order from the standard line or require special designs for specific installations, you are *certain* of satisfaction when you order Penberthy. Write for your copy of Catalog 35.

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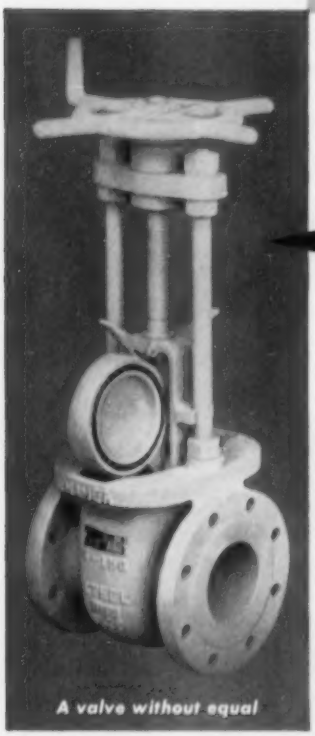

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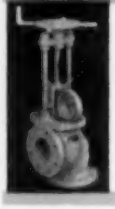
"Full-view" wedge. One glance determines whether line is full open or full close.



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Operator has complete control of the wedge at all times. Wedge pivots – no hand lifting necessary.

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Combining precision metal-to-metal fit of wedge and seats augmented by dependable seal rings, the new Visible Wedge provides the impenetrable sealing action of a Line Blind, yet maintains the simplicity of operation found in a gate valve.

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Pipeline Patrol

gas-gathering system for the Trans-Canada line. The 1956 stage of construction will total 219 miles and cost $22,650,000. The first part would start near Saskatchewan and include Pincher Junction, Provost, Bindloss, Sibbald, Oyen, Sunnynook, Steveville, and Cessford. The second part to be built in 1957 will consist of 328 miles and cost $24,400,000. The second phase will include Countess, Duchess, Princess, Homglen-Rimbey, and Nevis.

Attock Oil Co.—Company plans to build 60-mile natural gas pipeline from Dhulian field to Rawalpindi in West Pakistan

Cia. Shell de Venezuela. — Company has announced plans for a $21,000,000, 177-mile, 20-in. natural-gas line from La Paz field in the Maracaibo district to the Cardon refinery on Paraguana Peninsula. The gas will be used as the chief fuel in the refiner's furnaces. The line is expected to go into operation in 1957.

• **Empresa Nacional del Petroleo.**—80 miles, 10-in., planned, Concon to Santiago, Chile.

• **Gas Industrial de Monterrey.**—Company has announced plans for a 22-in., 130-mile natural-gas line from Reynosa to Monterrey in northern Mexico. The project will parallel a 14-in. line which has been supplying Monterrey since 1947.

Imperial Oil, Ltd. — This Canadian firm has let contract for 65 miles of 4 to 16-in. gas-gathering system in the Redwater area of Alberta.

• **Magna Pipeline Co.**—Firm has plans to build a $6,000,000 underwater line from Anacortes or Bellingham in Washington to Victoria. The line is expected to be completed by the fall of this year.

North Canadian Oils, Ltd. — Dutton-Williams Brothers, Ltd., of Edmonton, has contract for 136 miles of 10-in. line from Wabumun to Hinton, Alta. Mid-Western Industrial Gas, Ltd., which will supply gas along with North Canadian to a pulp mill at Hinton, will build a line from its gas fields in the Alexander, Majeka Lake, and Westlock districts to Wabumum.

Clearing has started and pipe will start about May 1. Crossings of the McCleod River, Pembina River, and Wolf Creek are being made early.

South Alberta Pipe Line, Ltd.—Company has filed permit to construct a 150-mile, 8-in. natural-gas line from Etzikom field to serve a nitrochemical plant to be built near Medicine Hat, Alta. The line will cost about $1,000,000.

• **Sui Gas Transmission Co.** — Pakistan Constructors, a joint company of Morrison-Knudsen, Boise, Idaho, and William Press, Ltd., London, have contract to build a 188-mile, 16-in. line from Sui gas field to Moultan, Pakistan. Work will begin in mid-1956. The line will later be extended to Lahore with branches at Kot Addu, Jhang, Magiana and Montgomery.

• **Trans-Canada Pipe Lines, Ltd.**—Firm extension of time limit to complete financing of 2,250-mile line from Alberta to Toronto and Montreal. New deadline is November 1, 1956. New deadline for exporting gas from Alberta is December 31, 1957. The Ontario government has agreed to help finance the line through its province. Tennessee Gas Transmission Co. has proposed a line to take gas from the company at Emerson, Man. (See Midwestern Gas Transmission Co.)

Westcoast Transmission Co., Ltd. — Company is starting work on a 650-mile, 30-in. line from the Peace River area in Canada to Sumas, Wash. Contractors are Mannix, Ltd., Canadian Bechtel, Ltd., R. A. Conyes Construction Co., and Dutton-Williams Brothers Co., Ltd. Clearing has started.

For the one tube steel to give you the longest tube life per dollar: *Ask the experts!*

CHANCES are that there are several different analyses of tube steel that could solve your particular combination of heat, corrosion, pressure and oxidation problems. But there is only *one* steel that can give you the lowest tube cost per year of required service—the best life/cost ratio.

To find that one steel, *ask the experts!* Ask the Timken Company metallurgists, recognized authorities on high temperature steel tubing. When you consult these experts, you get the benefit of over twenty years' experience with high temperature steels. From the wide range of Timken* fine alloy steels, they can help you select the one that is best for your requirements. And whatever analysis you choose, you'll be assured of uniform high quality. The quality of Timken steels is controlled from melt shop through to the final inspection with the most exacting methods.

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Carbon-Mo.	Sicromo 2½	Sicromo 5MS	16-13-3
DM-2	2½% Cr.-1% Mo.	Sicromo 7	25-20
Silmo	Sicromo 5	Sicromo 9M	25-12*
DM	4-6% Cr.-Mo.	18-8 Stainless	35-15**
2% Cr.-Mo.	4-6% Cr.-Mo.-Ti.	18-8 Cb	16-25-6**

*Available as seamless tubing on an experimental basis only.
**Not available as seamless tubing.

Chlorination apparatus purifies extracted non-metallic residues to determine steel cleanliness. It's another of the many aspects of high temperature steel research in constant progress at the Timken Company.

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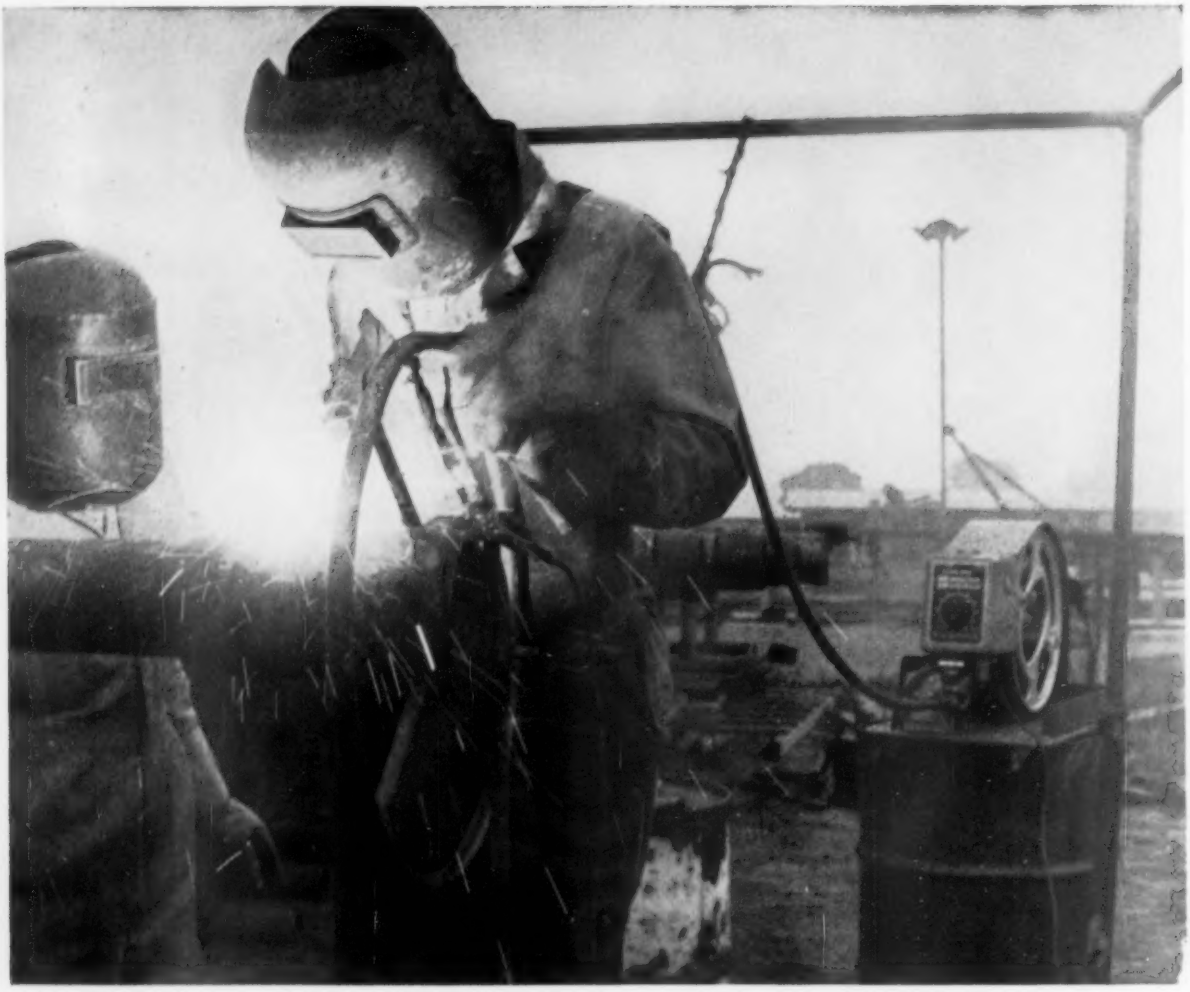

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With this new process, welding is FAST, at the rate of 12 to 15 pounds per hour; *four times that of manual application.* Abrasion resistance of this alloy is HIGH. Heat input is LOW. And the material cost is moderate. Semi-automatic welders are modestly priced but result in enormous savings in welding time.

Standard semi-automatic welders are readily adapted to the feeding of Stoody wires; only minor modifications are required—feed rolls and a simple nozzle are usually the only changes necessary.

Your Stoody dealer is prepared to give you complete information and literature on the Stoody semi-automatic wires now available for all welding purposes. Look him up in the yellow pages of your telephone book or, if more convenient, write directly to the company.

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See the STOODY EXHIBIT—WELDING SHOW—Buffalo, N. Y., May 9-11

Among the

Drilling Contractors

Lamar Drilling Co., Shreveport, has a new contract job under way for Hudson Gas & Oil Corp. and Byrd Oil Corp. at a wildcat location northwest of Lamar field, Franklin Parish, northeastern Louisiana. It is scheduled as a 5,500-ft. Tuscaloosa test at 1-A Hammons, in 32-16n-9e.

Tri-State Exploration Co., Denver, is scheduled for Dakota test to be drilled 5 miles southwest of Harrisburg, in Banner County, southwestern Nebraska. It is a contract job for E. L. Fundingsland. Location is for 1 Hughbanks, in 13-18n-57w.

Gene Reid Drilling, Inc., Bakersfield, Calif., is drilling on a 7,500-ft. contract job for Kernland Oil Co. at a wildcat location 5 miles southeast of South Cuyama field, at the southern end of Cuyama Valley, in Ventura County, southern California. Location is at 12-24 Dougherty, in 24-9-26.

H. L. Rowley, Inc., Shreveport, is drilling for Feazel interests and Gulf Refining Co. at a wildcat location 1½ miles northwest of Gilbert, in southern Franklin Parish, East-Central Louisiana. It is a Paluxy test with planned depth of about 8,000 ft. It is listed as 1 Turner, with location in 31-13n-8e. Location is about 8 miles northeast of Wisner field, and 15 miles southwest of Newlight field. These fields produce from the shallower Tuscaloosa formation.

B. G. Byars Power Drilling Co., Tyler, Tex., has a rig running for Sun Oil Co. on a wildcat operation 2 miles northwest of Jewett, in Leon County, eastern Texas. Location is at 1 Diehl, in the Daniel M. Frisman Survey.

Big 6 Drilling Co., Houston, has a wildcat operation under way on Galveston Island, Galveston County, Texas. It is a 7,100-ft. test for James H. Snowden. Location is 6 miles southwest of Galveston (city), in the Trimble & Lindsey Survey.

Fryer & Hanson Drilling Co., Dallas, is drilling another test for Temple Hargrove and associates in the Westwego area, southwest of New Orleans, in Jefferson Parish, Louisiana. It is a 9,100-ft. contract, the third on Hargrove's Marrero lease.

Sunnyland Contracting Co., Rayne, La., is scheduled for another Wilcox exploratory test in southwestern Franklin County, southwestern Mississippi. It is a contract job for Southern States Oil Co., of Laurel, Miss. Location, in 7-5n-1e, is 1½ miles southwest of

Drilling crews on El Paso Natural Gas Co.'s Cardwell rig No. 99292 which has completed more than 2 years of continuous operation without a lost-time injury. With the crewmen are H. L. Murray (lower right), tool pusher; and Marvin D. (Danny) Dunn (lower left), director of safety drilling operations.

Crewmen in the picture are: Bottom row, left to right (between Dunn and Murray), B. B. McLean, Jack Wright, and O. D. Nugent; second row, same order, B. D. Weaver, Melvin Johnson, Guy Bixler, Jr., and R. T. Jones; and, back row, W. L. Nugent, Robert Davis, Charles Werner, and H. L. Kitchens.

The rig, running in the company's San Juan division of northwestern New Mexico, southeastern Utah, southwestern Colorado, and northeastern Arizona, is under the general supervision of Wayne Dallas, drilling superintendent. T. J. O'Donnell is safety director.

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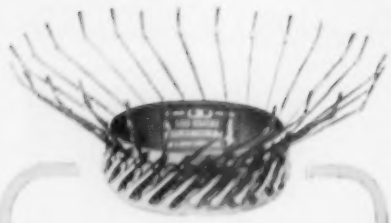

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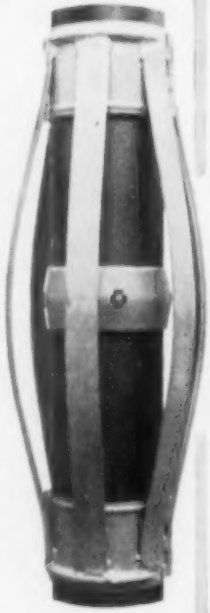

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South White Apple field, and 2 miles north of Flat Rock field.

Southwest Workover Co. is contractor on a new Atlantic Refining Co. wildcat operation 8 miles southwest of Corpus Christi, Neuces County, in Texas' lower coastal area. It is a 4,600-ft. job with location at 1 Russell, in Section 11, Laureles Farm Tracts, Ramon de Ynojosa Survey.

Ashby Drilling Co., Dallas, has contracted for a 9,000-ft. test to be drilled for Sam Recile Co., of New Orleans, at a wildcat location in southwestern Evangeline Parish, southern Louisiana. Location, at 1 Haas-Hirsch, in 11-6s-2w, is about 4 miles north of Basile field, on the Evangeline-Acadia parish line.

Loffland Brothers Co., Tulsa, will drill Union Producing Co.'s projected 12,000-ft. test in the West Bay area, in the delta marshes of Plaquemines Parish, coastal Louisiana. Sohio Petroleum Co. is joint operator with Union in the test, listed as 1 Tambour, in 29-22s-31e.

Doc Drilling Co., Franklin, La., has taken on a contract for a 17,000-ft. test Cities Service Production Co. will drill in the coastal marsh area of Lafourche Parish, Louisiana. Location, on a state lease, is offshore in Caminada Bay. It is 6½ miles southwest of Bay de Chene field.

Rocky Mountain Drilling Co., Los Angeles, has a rig working at the edge of Bakersfield, in Kern County, California. It is a wildcat location near the Bakersfield Airpark. Drilling is on a contract with Ohio Oil Co., which has scheduled a test to 8,500 ft. it is listed as 1 KCL-M, with location in 8-30-28.

Falcon Seaboard Drilling Co., Tulsa and Houston, has a new deep operation in the recently opened north extension area at Erath, in Vermilion Parish, Louisiana Gulf Coast. It is for Tide Water Associated Oil Co. at 1 Richard, in 8-13s-4e. Projected depth is 13,200 ft.

Woolf & Magee, Tyler, Tex., have moved back on a 10,336-ft. hole they drilled last year in Hancock County, coastal Mississippi, and will deepen it to about 11,500 ft. J. Willis Hughes, of Jackson, Miss., is the operator. The test, 1 Weston, in 34-8s-16w, is 3 miles northeast of Logtown. It is 8 miles north of Marshall Young's Lower Cretaceous oil-discovery well at Ansley, on the coast, in the southwest corner of the county. Producing zone in the Ansley well is at 10,850 ft.

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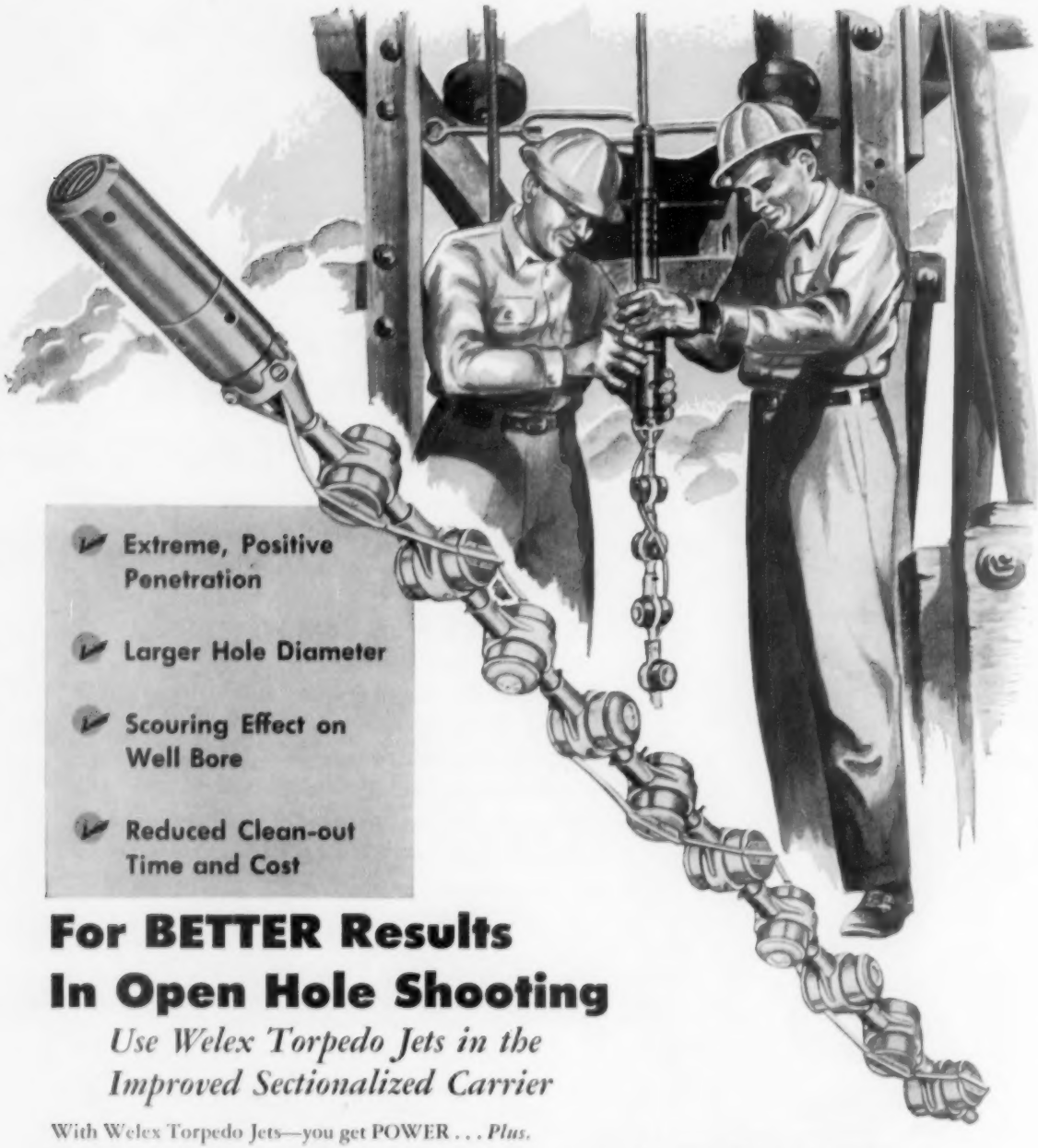

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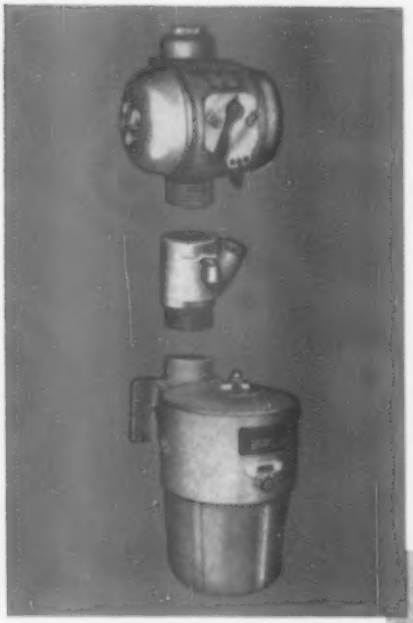

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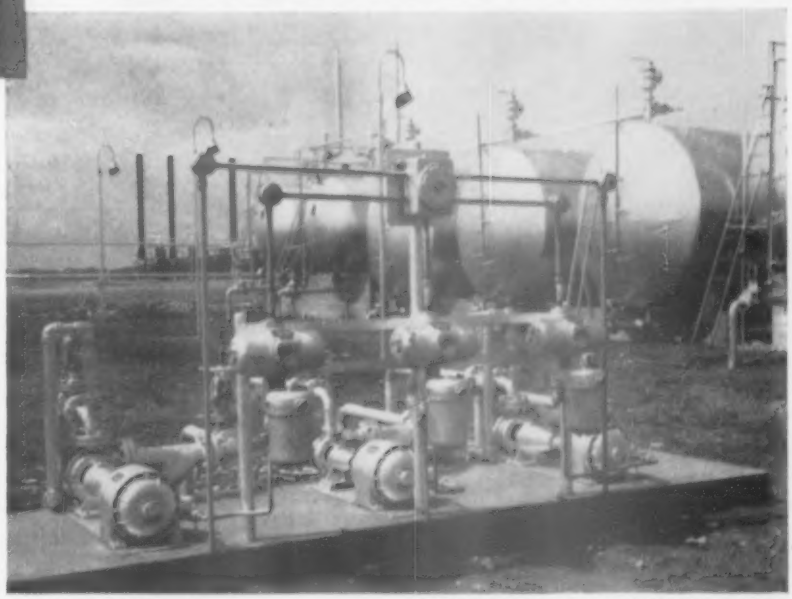

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APPLETON Circuit Breaker and Motor Starter Unilets on tank car loading pump motors in field processing plant.

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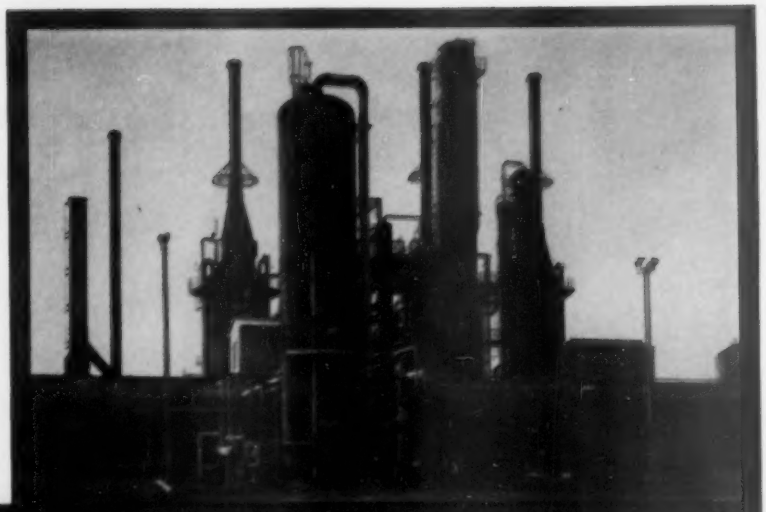

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Tretolite Fuel Emulsion Preventive is an organic, oil-soluble agent designed to prevent the emulsification and sludging of burning oils and diesel fuels. Oils treated with Tretolite Fuel Emulsion Preventive have shown no sludge formation even after a three month settling test.

Kuplex Metal Deactivator effectively deactivates copper in hydrocarbons such as gasoline, kerosine, jet fuel, diesel oil, furnace oil and turbine oil. Its powerful chelating action prevents hydrocarbon deterioration caused by metal catalyzed oxidation.

For complete information, technical data and prices, ask your Tretolite refinery service engineer or write to –

TRETOLITE COMPANY
A DIVISION OF PETROLITE CORPORATION
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TO 56-12

Chemicals and Services for the Petroleum Industry

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these ADVANTAGES mean lower costs on any oil-field job!

IF YOU never had a Northwest you should know more about the advantages that have put so many of them on the jobs of R. H. Fulton, Brown and Root and other pipeline contractors.

There is no service more rugged than pipeline work and Northwest has been pre-eminently successful in meeting tough conditions and giving exceptional performance with low upkeep cost in the hands of leading pipeline contractors.

Check over the list of advantages to the right, and compare them with others. Then let a Northwest man fill in the details.

NORTHWEST ENGINEERING COMPANY
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- "Feather-Touch" Clutch Control makes operation easy without complicated, delicate mechanisms.
- Wide range of Boom Hoist Equipment, including self-locking worm or independent high-speed boom hoists, giving live boom with, 1, 2 or 3 load lines.
- Uniform Pressure Swing Clutches eliminate the jerks and grabs that set a boom to jumping, and assure greater accuracy in setting and spotting loads.
- Ball and roller bearings on all high-speed shafts (standard on Northwests since the first one was built).
- Cast Steel Machinery Bases and Machinery Side Frames assure permanent shaft alignment and reduce wear.
- Helical gear drive running in oil—the finest thing in gearing—quiet, trouble-free.
- Positive Traction on both crawler belts while turning as well as when going straight ahead takes the larger Northwests where other similar equipment has difficulty.
- Fully convertible to Dragline, Shovel and Crane by simply changing booms.
- Northwest Dual Independent Shovel Crowd that utilizes force most independent crowd shovels waste.
- Cushion Clutch eliminates effects of shock overloads to parts under power before overload reaches machinery.

Four Northwest Model 41 Pullshovels on the Cities Service Pipeline near Newkirk, Okla. These are four of the 33 Northwests that have been bought by R. H. Fulton of Lubbock, Texas.

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- Saves Money
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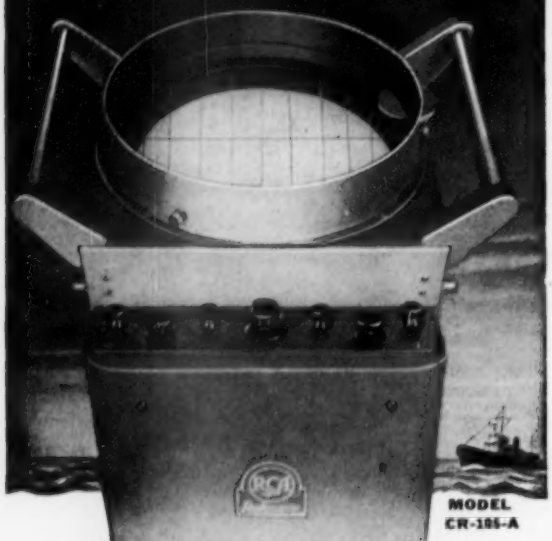

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Amazing NEW Oakite

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...Slashes tower down-time by more than 25%!

Texas refinery saves $1200 in ONE Cleaning Operation

Refiners everywhere are finding more and more uses for revolutionary Oakite RUSTRIPPER. This remarkable NEW alkaline material simplifies practically every cleaning job...reduces costs, too. Here's how amazing Oakite RUSTRIPPER saved one Texas refiner $1200 in a *single* cleaning operation:

The problem was to clean out a bubble tray tower in gas unit. Last conditioning job had taken a full 24 hours. This turned out to be an extremely expensive proposition since every hour of off-stream time cost this refinery $100.00! The superintendent agreed to give Oakite RUSTRIPPER a try.

After thoroughly rinsing the tower, a solution of Oakite RUSTRIPPER was pumped into the gas unit. Solution was circulated and agitated for necessary period, then re-routed through rest of unit and drained. A final circulating water rinse completed the reconditioning cycle.

Results? Oakite RUSTRIPPER had not only accomplished a cleaning job that was 95% perfect, but had reduced down-time by *six* hours, slashed cleaning costs by *$1200!*

Oakite RUSTRIPPER is also excellent for reconditioning salvaged parts, stripping paint from metal equipment, and many other heavy-duty refinery conditioning chores. RUSTRIPPER is safe, too...won't attack sound metal or give off troublesome fumes. Your local Oakite Technical Service Representative will gladly demonstrate remarkable Oakite RUSTRIPPER for you at your convenience. Call him today...no obligation. Or write Oakite Products, Inc., 48 Rector St., N. Y. 6, N. Y.

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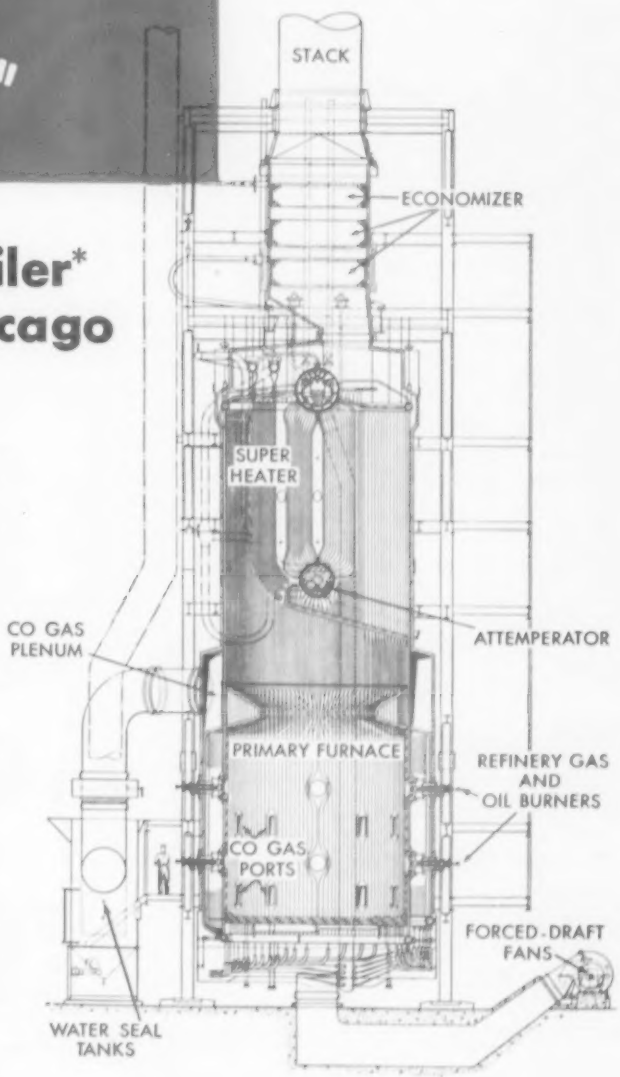
...New B&W CO Boiler* on stream at East Chicago

Recently, at the East Chicago, Indiana plant of the Sinclair Refining Company, a second B&W CO Boiler* was placed on stream. Sinclair, the originator of the CO Boiler as applied to Fluid Catalytic Cracking Units, made the first installation at its Houston, Texas refinery. As a result of the savings in fuel, Sinclair, in an advertisement, called it the "Thriftiest Boiler in the Business."

The new B&W CO Boiler for East Chicago differs from the first unit in that it has a cylindrical furnace that is surrounded by a water-cooled CO distributing chamber. Its compact design requires minimum floor space. This unit is the first of this design and promises to effect significant savings, as with the first unit. The Sinclair Refining Company is to be doubly complimented on its leadership and pioneering in turning waste gases to useful purposes.

We will be glad to furnish you with full details of the B&W CO Boiler and what it is doing for others, and can do for you. The Babcock & Wilcox Company, Boiler Division, 161 East 42nd Street, New York 17, N. Y.



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BOILER DIVISION

*Carbon Monoxide Boiler

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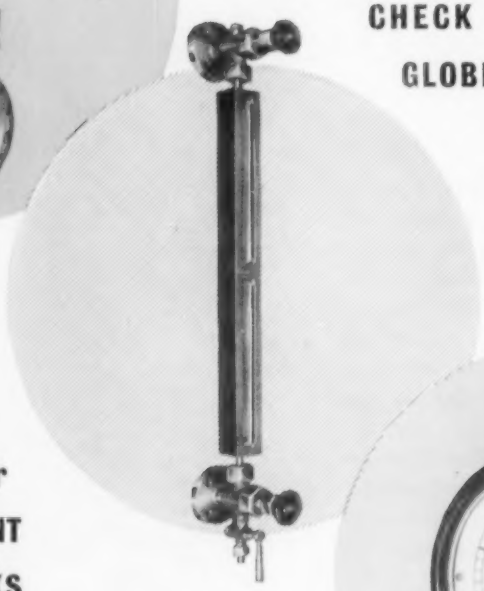

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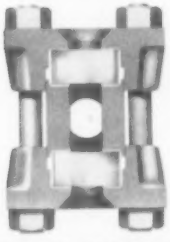

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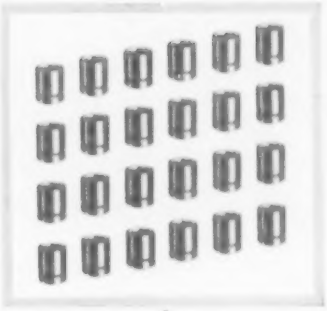
LOOK HOW *Snap-on* TOOL SPECIALISTS CUT SOCKET BREAKAGE 20-FOLD FOR INDUSTRIAL FIRM



R. J. RIPPLE

problem:

A large Milwaukee industrial concern was breaking an average of a socket per day on nut-running jobs handled with high-cycle nut runner. This not only meant tool replacement expense, but even more important, a loss in production time.

solution:

The problem was turned over to a *Snap-on* tool sales engineer, R. J. Ripple, who went over it in detail with his factory laboratory experts. They found that the socket used was not designed to handle the type of work involved. A new, special heat-treated socket was developed to meet the job requirements. Now socket breakage is less than one a month, lost time is negligible.

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If you have a production or maintenance problem involving special tool design or application, or any other question on tools, talk it over with your *Snap-on* man. He is a specialist who devotes all his time to industrial application of *Snap-on* tools. Write us or call your nearest *Snap-on* branch. Free catalog of industrial wrenches and hand tools is yours for the asking.

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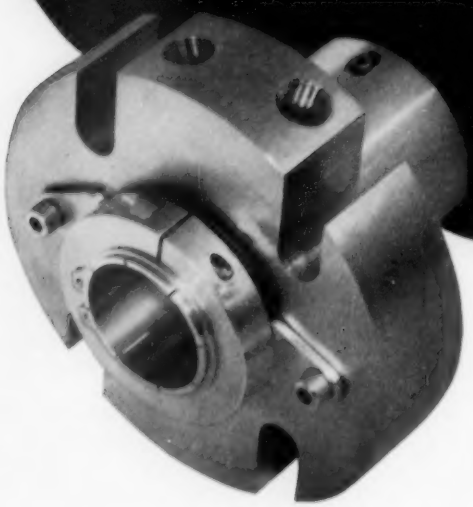

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Reports from users during the past 16 years show that Kennametal lasts 20 times longer than steel and 3 to 5 times longer than special and super alloys.

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Kennametal API Balls and Seats are available at repair shops of most major pump manufacturers. Ask your service man to standardize on them. *They'll cost you less in the long run.* KENNAMETAL INC., Latrobe, Pennsylvania.

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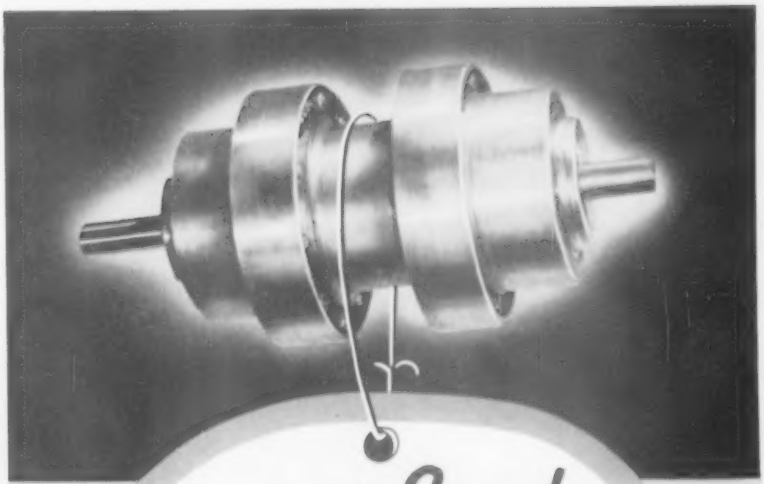

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Snap size head you want into ratchet drive ring, from either side—it can't fall out. Dies reverse easily for close-to-wall threading. 00R and 0R, ⅛″ to 1″; 111R and 11R, ⅛″ to 1¼″; 12R, ⅛″ to 2″. Free carrier with sets. Conduit and special dies available. Real work-savers—at your Supply House!

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The pump/motor used for the pull-down is only 9 inches long, weighs only 19 pounds . . . *yet has enough power to actually lift the truck off its wheels.*

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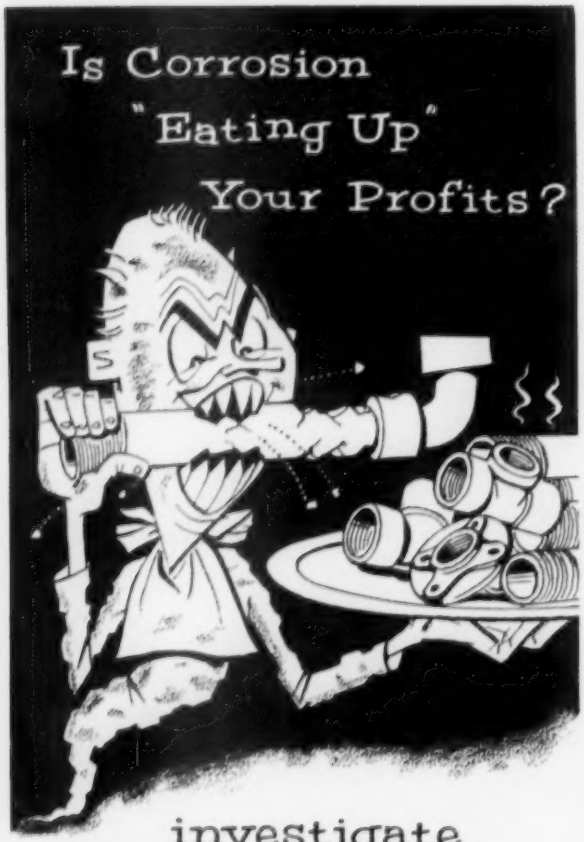

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840 pages, 6x9, 179 tables, 268 illustrations, $10.50

THIS manual gives a step-by-step presentation of refining methods . . . revised and extended physical data . . . and practical details on plant operations in the light of today's costs. Typical of the up-to-date treatment is the inclusion of topics like catalytic cracking, solvent treating, mercaptan dissolving processes, azeotropic distillation, etc.

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EQUIPMENT MEN . . . in the News

H. C. Smith Elects New Officers, Directors

Shown above are the new officers and directors of the H. C. Smith Oil Tool Co., elected at the recent annual meeting of stockholders and directors. Seated, left to right: Herschel C. Smith, executive vice president; Herman C. Smith, president; Donald E. Graham, vice president, operations, and secretary. Standing, left to right: Arthur S. Marshall, vice president, sales; Robert L. Flynne, vice president, finance, and treasurer; Kenneth H. Swart, vice president, engineering; and Franklin L. Stamm, director. Herman C. Smith, Herschel C. Smith, and Marshall were reelected directors. Graham, Flynne, Swart, and Stamm are newly elected members of the board. Stamm is head of F. L. Stamm & Associates, management consulting firm.

R C A Names Microwave Engineer to Tulsa Post

B. R. DEAN

The Engineering Products Division of Radio Corp. of America has announced the appointment of B. R. Dean to the Tulsa office to handle engineering and sales of microwave equipment to the petroleum industry in the Mid-Continent and Gulf Coast areas.

Prior to his appointment to the Tulsa office, Dean spent 3 years in Europe during which time he supervised the installation of an extensive microwave system for the North Atlantic Treaty Organization. He also supervised the training of personnel to operate the system.

Until this appointment, the sale and engineering of microwave systems has been handled from the Camden, N. J., office of R C A. Sales and engineering of mobile-communications equipment to the petroleum industry in the Mid-Continent area will continue to be handled by R. T. Huntington. K. R. McHenry, Dallas, is regional manager of mobile-communication sales.

Dewey Supply Elects Roach as President

M. B. ROACH

M. B. Roach has been named president by the board of directors of Dewey Supply Co. Roach was with New York Belting & Packing Co. in Dallas and later took the position as regional sales manager for Dayton Rubber Co. in Dallas.

Other officers elected to the board of directors were: David A. Bartlett, vice president and treasurer; Dewey F. Bartlett, chairman of the board; and Wilbur J. Holleman, vice president.

Clint Beard, vice president of Dewey Supply, has opened a sales office for the company in Bartlesville, Okla.

Lastrapes, West Join Oil Center Tool Sales

Gil Lastrapes and George West have recently joined the Oil Center Tool Co. sales organization, John Maher, president, has announced. Lastrapes, who was formerly with Orbit Valve Co., will represent OCT in the South Louisiana area. He will headquarter in Lafayette, La.

West has been assigned to the Williston basin area. He will make his headquarters in Williston, N. D.

Lufkin Foundry Promotes Roe

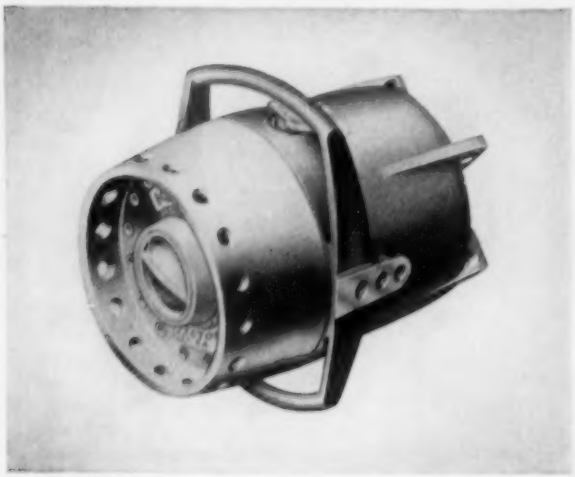
The transfer of Jim Roe from Odessa to Dallas, Tex., and his promotion to

Wagner-Morehouse Names Continental As Distributor

The appointment of Continental Supply Co. as distributor of Wagner-Morehouse oil-field equipment has been announced. The agreement gives Continental exclusive distribution of the complete line of Wagner-Morehouse mobile-drilling and well-servicing units in Canada and the United States, except in the states of California, Oregon, and Washington. Discussing the new management are, left to right: J. Allen Whitesides, manager, drilling equipment division, Continental, Dallas; John C. McClure, sales manager, Wagner-Morehouse, Los Angeles; and J. A. Mussler, general manager of sales, Continental, Dallas.

The KEL-RAY Projector

a portable tool for low-cost radiography



Here is a new development employing radioactive cobalt, iridium, or cesium as a source of gamma rays. One of the most practical means yet devised for industrial non-destructive testing, the KEL-RAY Projector lowers costs and simplifies procedures wherever radiographic testing can be applied. Here's why:

PORTABLE—Requiring no external power, the KEL-RAY Projector is available in three portable sizes, the smallest of which can be moved by hand.

SAFE—Ruggedly constructed, equipped with tamper-proof shutter, it is designed and built to keep radiation leakage at a minimum—well below AEC and ICC safety requirements.

ECONOMICAL—Initial and operating costs are low. Requires no maintenance during life of isotope. Set-up time and man-power are minimized.

EASY TO USE—Simple to operate on light or heavy material up to 8 inches thick by anyone properly trained.

For information on how the KEL-RAY Projector can meet your needs, write for Bulletin PI960.

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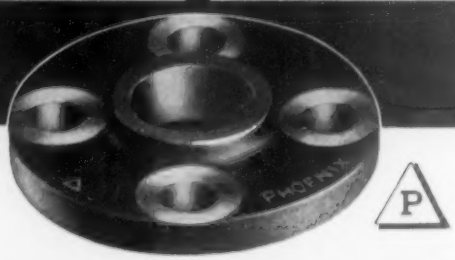

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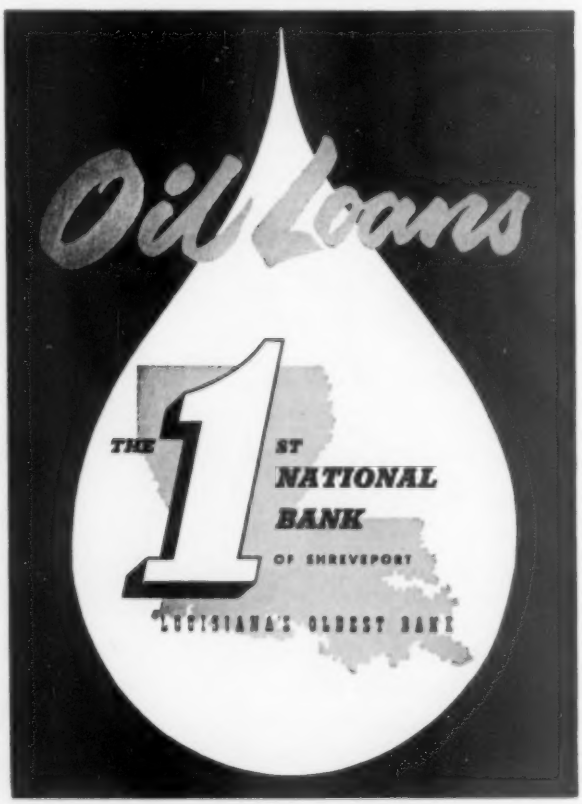


sales engineer has been announced by Lufkin Foundry & Machine Co.

Roe was service engineer at Odessa for Lufkin from early 1954 until his recent transfer.

Rockwell Names District Sales Manager, Two Others

T. O. CARSON

A new Pittsburgh district sales manager and two assistant product managers have been announced by Lloyd A. Dixon, Jr., vice president in charge of Rockwell Manufacturing Co.'s meter and valve division. Thomas O. Carson, formerly manager-distributor sales and assistant product manager, Nordstrom valves, now heads the division's district sales headquarters offices in Pittsburgh.

C. B. Goff, Jr., and A. J. Komich will serve as assistant product managers, respectively, of Nordstrom valves and petroleum and industrial meters.

Carson joined the company as a water-meter salesman in 1935. He later traveled Mexico, Cuba, Puerto Rico, and Canada as a sales engineer in the subsidiary, Rockwell International Corp. From 1949 to 1954 he managed the international department of the New York district sales office, then was transferred to Pittsburgh as assistant product manager, Nordstrom valves. In 1955 he was also named manager-distributor, sales.

Goff joined Rockwell as a sales engineer in the Pittsburgh district office in 1949. Komich, who joined Rockwell in 1946 as a sales engineer, was named Boston district gasoline and oil-products supervisor in 1951.

Western Co. Promotes Helm and Simmons

C. V. Helm and Charles Simmons, former district managers at Healdton, Okla., for The Western Co., have been promoted to regional operations managers. Helm will handle the West Texas-New Mexico and Simmons the North Texas - Oklahoma region. Both will be headquartered in Midland, Tex.

Other Western changes are: Jack F. Gordon, former manager of the Odessa, Tex., district, becomes chief pumping-services engineer in Midland; V. J. Mercier, named chief wire-line engineer there; James T. Wilson, district manager, transferred from Borger to Odessa, Tex.; and Floyd Helms and Tom Lucas promoted to field supervisors in Odessa.

Maugis Goes to French Affiliate of Rogers

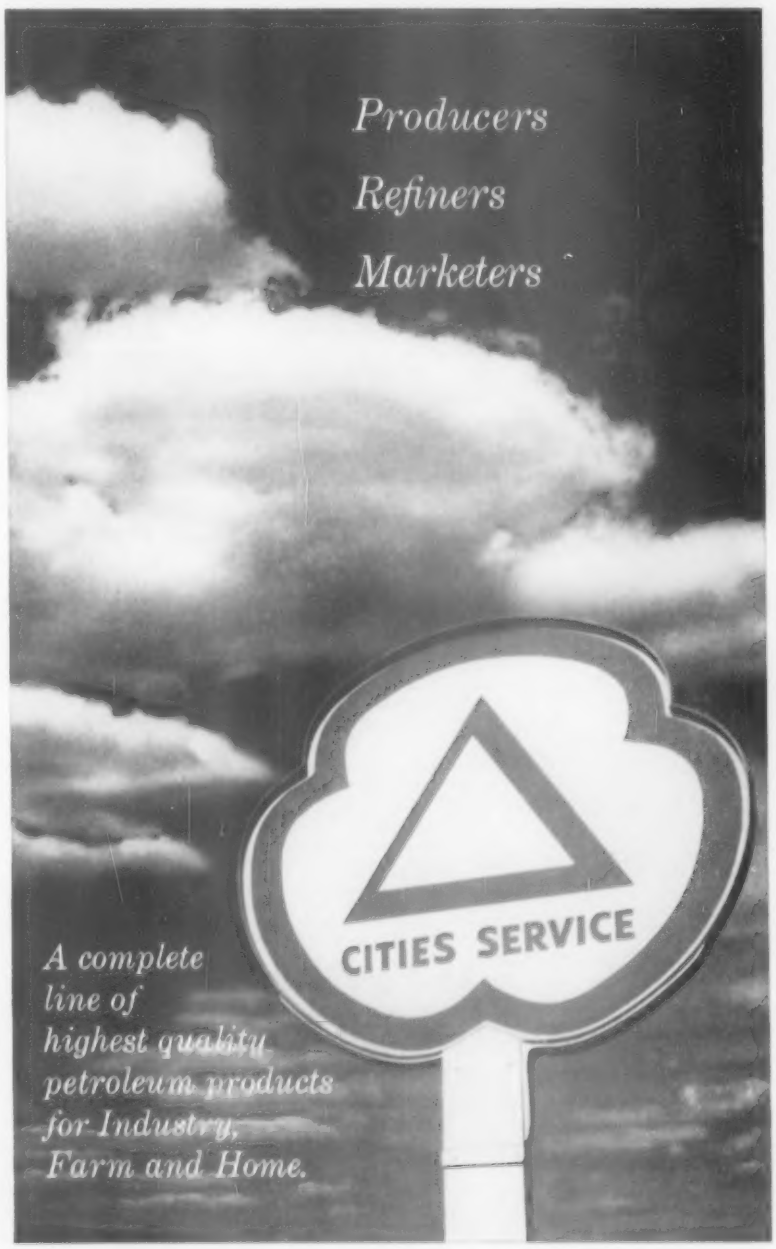
PIERRE MAUGIS

Appointment of Pierre Maugis as director of Exploration Geophysique Rogers, Paris, France, has been announced by S. D. Rogers, president of Rogers Geophysical Co. Exploration Geophysique Rogers is an affiliate of Rogers Geophysical Co. of Houston. Maugis will serve as director of this company in France and the French Union.

Tube Turns Makes Sales Organization Changes

Four changes in territorial assignments have been made by the sales department of Tube Turns, Louisville, Ky., a division of National Cylinder Gas Co. The announcement was made by John G. Seiler, executive vice president and general sales manager.

Earl R. Muir, Jr., formerly district manager at Seattle, has been transferred to Louisville, where he will be-



come manager of the newly formed central district, comprising Kentucky and southern Ohio, Indiana, and Illinois. Richard T. Burke, formerly a member of the Houston office staff, has been appointed Muir's successor as district manager at Seattle.

Vernon Shallcross, a member of the staff of the Tulsa office, has become a company representative in the Denver territory.

W. C. Robinson, formerly assistant sales manager of the eastern division, has been assigned to special promotional programs and attached to the Pittsburgh office.

Kaiser Makes Erlin General Sales Manager, Fabricating

Richard L. Erlin has been appointed general sales manager of Kaiser Steel Corp.'s fabricating division plants at Napa and Fontana, Calif., Ernest L. Ilsley, general manager of the plants, has announced.

Before being named to his present position, Erlin was manager of engineering sales for Kaiser Steel in Oakland. He joined the company in 1944 as sales representative after being with United States Steel for 15 years. He became manager of central district sales in 1947 and soon thereafter joined Kaiser-Frazer at Willow Run, Mich.

Erlin served as assistant to the vice president, sales, for Louis Berkman Co. of Steubenville, Ohio, from 1949 to 1955 when he rejoined Kaiser Steel as manager of engineering sales.

Security Names Chandler Manager, Special Sales

A. G. CHANDLER

A. G. Chandler has been appointed manager of special sales for Security Engineering Division, one of the Dresser Industries, by A. M. Birnie, vice president in charge of sales for this rock-bit and oil-tool-manufacturing firm.

Chandler was manager of an American-owned oil-tool-manufacturing plant in Holland, prior to joining Security. His sales experience includes assignments in 37 countries throughout Europe, Asia, and the Middle East.

Chandler began his oil-industry career in 1936 with a Houston oil-tool firm. Until 1949 he worked in various sales and sales-executive capacities throughout the Mid-Continent and Gulf Coast areas. For the past 6 years, he has been engaged primarily in oil-equipment sales work outside the continental United States.

In his new assignment, Chandler will headquarter in Dallas, home office for Security.

Winter Heads Area Sales, Service for Franks

JOE M. WINTER

Joe M. Winter has been appointed manager of sales and service of the California district for Franks Division, Cabot Shops, Inc., according to S. E. Corry, Franks sales manager. Winter, who has been assistant sales manager and service manager of the Compton office and repair shops, is replacing R. M. White, who has resigned.

Winter has been with the Franks organization since 1950 and has worked in most of the departments of the Franks Tulsa plant. He served as service manager in California in 1952 and was sent to Edmonton, Alta., in 1953 to open up a Franks division there where he served as sales and service manager.

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Chicago, Ill.—Harry A. Jay, Suite 1090, Old Colony Bldg.
Denver, Colo.—Earl H. Jones & Co., 1863 Wazee St.
Detroit, Mich.—R. W. Long, Jr., 505 Park Ave.
Erie, Pa.—R. J. Maggi, Box 711
Falmouth, Mass.—Walter S. Bennett, 53 Minot St.
Houston, Tex.—Henry H. Paris Distributor, Inc., Box 932
Los Angeles, Calif.—James A. Riordan Co., 1400 Santa Fe Ave.
Louisville, Ky.—Sid Schultze Co., 514 West Main St.
Milwaukee, Wis.—M. A. Nelson Co., 3347 N. 97th St.
Minneapolis, Minn.—Lin J. Krause, 5605 Lyndale Ave. S.
Narberth, Pa.—J. W. Worthington, 105 Forrest Ave.
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New York, N. Y.—Max Rothenberg, 11-05 38th Ave., Long Island City
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Schlumberger Announces Key Executive Changes

Nick A. Schuster has been appointed head of the electrical engineering department of Schlumberger Well Surveying Corp. to succeed J. M. Bricaud. Bricaud has returned to Paris, France, to assume his position of director of engineering for Societe Prospection de Electrique (S.P.E.). This company renders Schlumberger services in Europe.

N. A. SCHUSTER

J. M. BRICAUD

Schuster served as research physicist in Schlumberger's research laboratory at Ridgefield, Conn., from 1951 until his assignment to Houston.

Bricaud came to the United States in 1947. He had formerly served in the engineering department of S.P.E. from 1937 to 1947.

Alten Foundry Appoints Area Representative

The appointment of S. W. (Sandy) Collins as representative in the Indiana-Illinois-western Kentucky area has been announced by Warren M. Benson, vice president of the Alten Foundry & Machine Works, Inc.

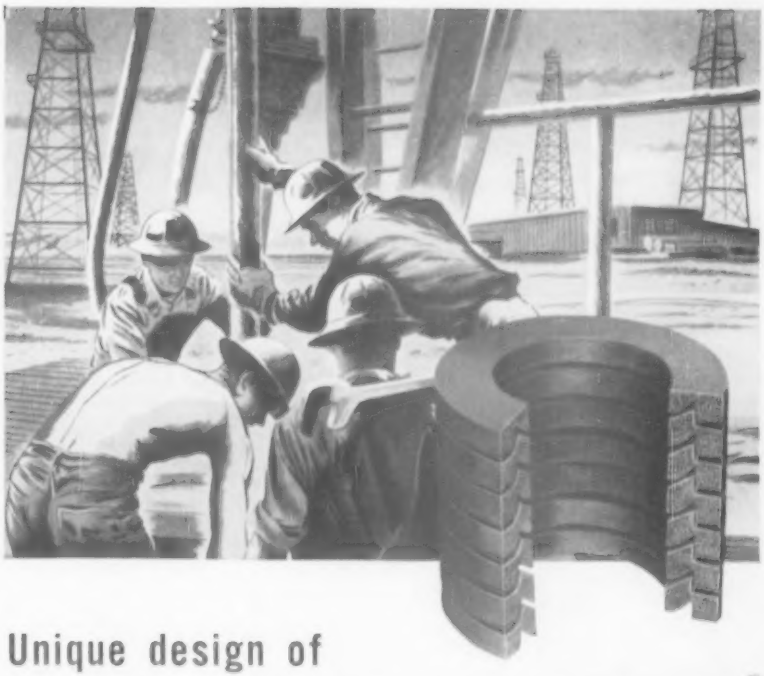
Collins has been active in the petroleum industry since 1930. His wide experience includes field and supply-store sales as well as district and regional sales positions.

Grant Expands Gulf and California Service

JOHN KINKAID

Grant Oil Tool Co., Los Angeles, has announced immediate expansion of its service coverage in the Gulf Coast area and in California, according to Robert E. Ringle, Grant sales manager.

Grant has opened new service facilities and warehouse at Harvey, La. John Kinkaid has been transferred from Lafayette to Harvey, where he will manage the new facilities. New field representative for Grant at Lafayette



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is Joe Jennings, transferred to his present post from the Los Angeles Basin branch.

Titus (Nick) Carter has joined the Grant sales organization as a field salesman in the Los Angeles Basin area.

Kinkaid started his oil-business career with Grant in Hobbs, N. M., as a field salesman, after having worked for a major bit manufacturer. In 1955 he was promoted to office manager of the Lafayette branch of Grant Oil Tool, where he served until his present transfer and promotion to assistant district manager of the Louisiana branch, working out of Harvey.

Elgen Starts Contsruction on New Dallas Facility

The Elgen Corp., electrical well-logging service organization, began construction this week of this home office building on a five-acre tract in the Bluff View Industrial district of Dallas. Completion of the building is scheduled for July 1. The Elgen Corp.'s new quarters will house administrative offices, research laboratories, manufacturing area, and machine shop. Elgen's services include basic electrical well logging, Permalogging, geophone, and hole caliper. With 15 field laboratories now in use, Elgen will have increased its truck units by August to handle the logging of 800 wells per month.

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SAN ANTONIO, TEXAS

Pitcher Named General Mgr., Graver Construction

H. C. Pitcher has been named general manager of Graver Construction Co., Inc., a subsidiary of Graver Tank & Manufacturing Co., Inc.

Formerly construction manager of M. W. Kellogg Co., Pitcher has had over 20 years' experience in the building of industrial plants throughout the United States. Starting as a field engineer for Kellogg, he has built facilities of every type for such industries as oil, chemical, steel, power and atomic energy.

Besides its New York headquarters, Graver Construction Co., Inc., maintains offices in Chicago, Houston and Tulsa.

Bourdo to Represent Web Wilson in Near East

K. L. (Kenny) Bourdo is now representing Web Wilson Oil Tools, Inc. in all oil-producing areas of the Near East, including also Egypt, Tunisia, Ethiopia, and the Sudan.

Bourdo possesses extensive knowledge of drilling equipment and methods. He has in the past 2 years developed a considerable acquaintance throughout the Near East.

Weco Names Wood to Rocky Mountain Area

Junior Wood has been appointed sales representative for the Rocky Mountain area of Well Equipment

Manufacturing Corp., according to an announcement by John Gates, sales manager.

Prior to joining Weco, Wood had 5 years oil-country experience with National Supply Co. as production engineer wellhead engineer, sales representative, and assistant store manager in the Houston district. Before assuming his sales duties in the Rocky Mountain area, with headquarters in Denver Colo., Wood spent 30 days in Weco's Houston plant familiarizing himself with Weco unions, blocks, and compounds. As a Weco representative, Wood will also represent Chiksan Co. for swivel joints, steel rotary hoses, and mud guns.

Otis Appoints Rich to Vice President

W. E. Rich has been appointed vice president of Otis Pressure Control, Inc., and Otis Engineering Corp., its manufacturing affiliate, Herbert C. Otis, Jr., executive vice president, has announced in Dallas.

Rich is also treasurer of the two corporations. He has been with Otis 19 years.

National Geophysical Names Hake Supervisor at Midland

Stanley L. Hake has been appointed supervisor of the Midland district for National Geophysical Co., Inc., as announced by W. R. Mitchell, executive vice president. Hake will headquarter in Midland.

Prior to joining National Geophysical, Hake served 5 years as supervisor in the Midland district for a contract exploration company. Previous to that position, he served 8 years with Texas Co.

Beaird Makes Shifts in Compressor Sales Group

W. W. SENTELL

William W. Sentell, sales engineer in the compressor sales division of The J. B. Beaird Co., Inc., for the past 10 years, has been promoted to assistant sales manager of the division, John L. Tullis, vice president and general manager of sales, has announced.

W. F. Raynolds has been transferred as sales engineer from the Midland district to the Tulsa area, formerly served by Sentell. J. R. Sims, formerly general manager of the Shreveport engi-

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neering service company, has joined the Beaird compressor sales division as sales engineer for the Midland district.

Associated with Beaird since the creation of the compressor sales division, Sentell has been instrumental in helping to develop new and varied uses for packaged compressor units. In his present capacity as assistant sales manager, Sentell will assist divisional Sales Manager E. S. McRoberts to expand the market for Beaird's complete line of packaged compressor plants.

Beckman Adds Houser to Application Engineering

Edwin A. Houser is an important addition to Beckman Division's application engineering staff. Houser was formerly instrument and application engineer for Phillips Petroleum Co.

Houser has been assigned to work on applications dealing with process monitoring instruments manufactured by Beckman Instruments, Inc. Houser will work on sampling-system applications for all Beckman process instruments, it has been announced by Henry J. Noebels, application engineering manager.

Houser joined Phillips in 1953. At Phillips he worked on the application of process monitoring instruments to the petroleum industry with particular emphasis on the design of sampling systems.

McCullough Appoints Three in Sales Organization

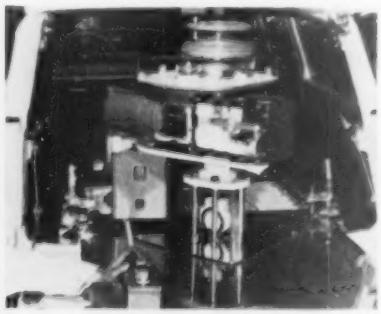
Appointments of E. H. Lain and John Watson to assistant eastern division sales managers and Olin M. McGrew as sales engineer at Kimball, Neb., have been announced by O. J. McCullough, vice president of McCullough Tool Co.

Lain will coordinate sales activities in the Gulf Coast area from the eastern division headquarters in Houston. Watson will head the McCullough sales team in the Dallas-Fort Worth area, making his headquarters at the Dallas sales office. Both men will serve under the direction of J. A. Williams, eastern division sales manager.

Lain entered the sales department in 1951 and was promoted 3 years later to district sales manager. Watson was associated with Gulf Oil Corp. before joining McCullough in 1951. He progressed from the field and shop to sales and was made a district manager in 1954.

McGrew joined McCullough in 1948 as a rigger. He later worked as a line-truck operator at Sterling, Colo., before being transferred to Kimball as sales engineer.

Demonstration Units Show Torkmaster Valve Operators



Torkmaster Division of Harvill Corp., Los Angeles, and Torkmaster distributors throughout the nation use these station wagons to demonstrate the Torkmaster valve-operating unit to customers. Division Manager Kenneth McBain estimates that each mobile unit rolls up more than 35,000 miles yearly in demonstrating the unit in all parts of the nation. The Torkmaster valve-operating unit operates by electrical control all types of conventional gate, globe, plug, butterfly, or other valves in sizes of 1½ in. or larger.

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FINE
THROUGH THE SHAKER SCREEN
...engineered for lost circulation control
★ HIGHER STRENGTH SEAL
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TUF-PLUG
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A GRANULAR BRIDGING AGENT
AVAILABLE THROUGH YOUR LOCAL MUD AND SERVICE COMPANIES
CHEROKEE LABORATORIES, Inc.
HOME OFFICE AND MANUFACTURING PLANT IN TULSA, OKLAHOMA

Sivalls Tanks Opens Sales Office, Names Salesmen

Opening of a Fort Worth sales office, appointment of a new Abilene branch manager, and the appointment of several sales and service representatives have been announced by I. W. Lovelady, president of Sivalls Tanks, Inc. Jack Briggs has opened offices for the company in the W. T. Waggoner Building in Fort Worth. The former Odessa salesman and Abilene branch manager will cover the Fort Worth-Dallas area.

JACK BRIGGS

J. R. FRYMIRE

Shifting to Abilene as branch manager is J. R. (Bob) Frymire, former San Angelo sales and service representative. He will represent the company in the North and West Central Texas areas centering on Abilene, Sweetwater, and Wichita Falls.

Two salesmen have been assigned to sales territories in West Texas. They are Bob Dozier, who is working out of Odessa, and Jerry Poole, Jr., who is the new San Angelo sales and service representative.

Briggs joined Sivalls in 1950. Frymire started with the company in 1949 and served as office sales supervisor in Odessa prior to his transfer to San Angelo in April 1954. Dozier joined Sivalls as a trainee in 1955 following 2 years with Union Oil Co. of California in Midland. Poole started with Sivalls as a trainee in 1955 and is a former employe of Gulf Oil Corp.

Republic Supply Announces Promotions, Transfers

The Republic Supply Co., through M. N. Amsden, vice president and general sales manager, has announced three promotions and transfers.

C. J. Jump is manager of the Houston sales office. He was transferred from Denver where he has been sales office manager and district manager for the Rocky Mountain area since 1953.

M. D. Gilmore replaces Jump at Denver. D. D. Dennington, field salesman at Fort Morgan, is now store manager at that point.

Jump has been with Republic since

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KOHLER Electric Plants for stationary, portable and offshore rigs

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MODEL 5MH22, *5KW, 115 volt AC. Manual starting, with housing.*

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Heavy-duty 5 KW model provides reliable power for rig lights, floodlights, maintenance tools—also mobile service on portable rigs. Operates with gasoline or natural gas. Engine is 4-cylinder, water-cooled. Other sizes, 500 watts to 35 KW includes portable models for seismograph equipment, tape recordings, geophysical survey trucks. Diesel models available, 10 KW to 35 KW for lighting and galley equipment on quarter boats. Also stand-by models for refineries. Write for folder P-24.

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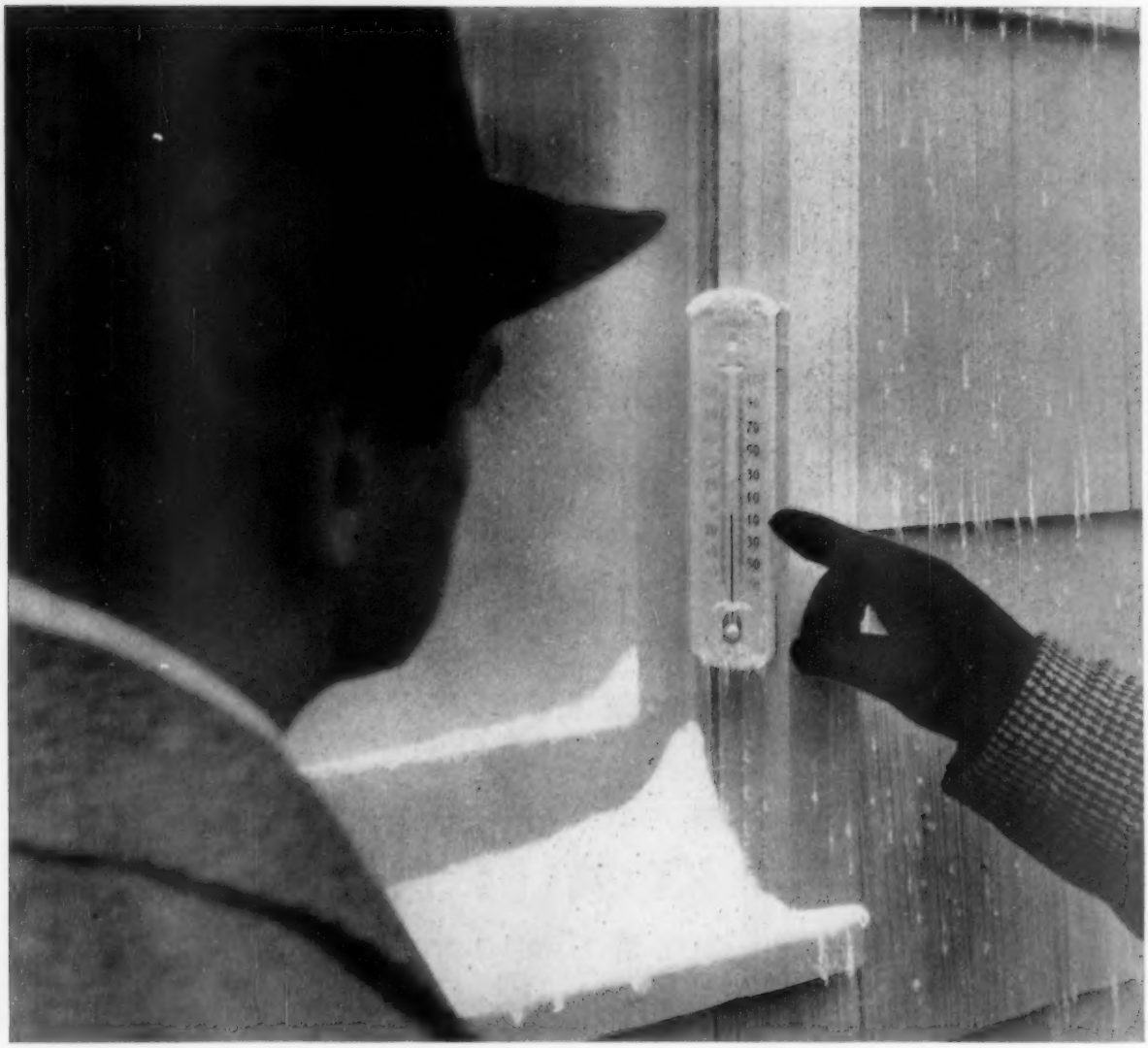

"Cold weather reminds me of what Pritchard did at Tioga!"

"What has Pritchard got to do with the weather? And where or what is Tioga?"

"Pritchard had plenty to do with the weather! You mean I've never told you about Tioga?"

"No, you haven't. What is it?"

"Tioga is a place in North Dakota where Signal Oil and Gas Company has its new natural gasoline plant. Now, that's where Pritchard really went to work! They designed and engineered the whole plant. They sure had a tough weather problem to whip!"

"Was it bad?"

"Bad? I'll say so! Down to minus 40 degrees or less in the winter and then up to 110 in the summer. You know how they solved it?"

"How?"

"Dry distillation! They didn't use a bit of steam in the gasoline recovery process. Imagine, gasoline recovery without using any steam. You know, I'm not too surprised."

"What makes you say that?"

"I know Pritchard. They cut their eye teeth on problems like Tioga."

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"Cold weather reminds me of what Pritchard did at Tioga!"

Dry Distillation Features Signal's Tioga Plant— Designed and Engineered by Pritchard

Signal Oil and Gas Company's new Tioga, North Dakota natural gasoline plant features dry distillation, with no steam used in the gasoline recovery process.

The entire plant was designed and engineered by Pritchard.

This plant was designed for extremely cold weather operations, with temperatures —40° F. or below in the winter; up to 110° F. in the summer.

Just another in the long parade of successful installations, the Signal plant is further proof that Pritchard designers and engineers have the skill to design facilities for you.

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1945, when he started work as a floorman at Big Spring, Tex. Later he was store manager at Kermit, special assistant to the district manager at Odessa and then went to Denver.

Gilmore began work with Republic in 1946 as a floorman in Olney, Tex., later became manager at Olney, Farmington, N. M., and Fort Morgan, Colo.

Harrisburg Sales Makes Stewart District Manager

R. T. STEWART

The promotion of R. T. Stewart to district manager has been announced by President A. B. Quinn of Harrisburg Sales & Service, Inc. Stewart will be responsible for Harrisburg sales and activities in South Texas and East Texas. The new district manager will continue to office at the company's building in Houston.

A new location for Harrisburg Sales & Service has been established at Casper, Wyo., where B. C. McBride is sales engineer. Quinn also announced new sales engineers for the organization: D. R. Glosson in Houston; Charles Cook in Odessa, Tex.; and J. R. Floyd in Oklahoma City.

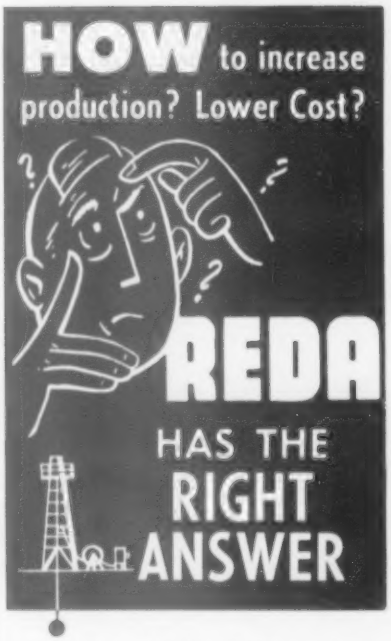
Lunkenheimer Names Venable To Houston Headquarters

Appointment of Tollie C. Venable as sales representative for Lunkenheimer Co. has been announced by Melvin W. Pauly, vice president in charge of sales of the Cincinnati, Ohio, firm.

Venable, with headquarters at Houston, was with Corbett Corp., Houston, as sales representative before joining Lunkenheimer. He was previously sales representative for the Norvell-Wilder Supply Co. and was with Crane Co.

Oilwell Appoints Seven Field Representatives

The appointment of Dean L. Cook, Leslie G. Hooks, and Rudolph L. Wiley as field representatives at McAllen, Tex., Houma and Harvey, La., has been announced by M. F. Jones, Gulf Coast area manager of U. S. Steel's Oil Well Supply Division. Harold E. Reeves has been appointed field representative at Fairfield, Ill., it has been announced by C. H. Maynard, Oilwell's eastern area manager. William Miskimins, Central Midwest area manager, has an-



. . . from ½ HP to 300 HP . . . from 20 bbls to 25,000 bbls . . . from 200' to 10,000' and more . . . Yes, a REDA will do that pumping job BETTER . . .

Reda Pumps are used as original equipment, or replacement equipment, because they produce at a lower cost per barrel of fluid. Whether it's large volumes from shallow depths, or modest volumes from great depths, Reda Pumps provide operating savings.

IMPROVED DESIGN:

Constant research and design improvement are responsible for lengthened operating life, corrosion resistance, low labor cost per barrel of fluid produced.

IMPROVED EFFICIENCY:

Greatly improved overall efficiencies have improved Reda performance as much as 25%; a substantial operating saving.

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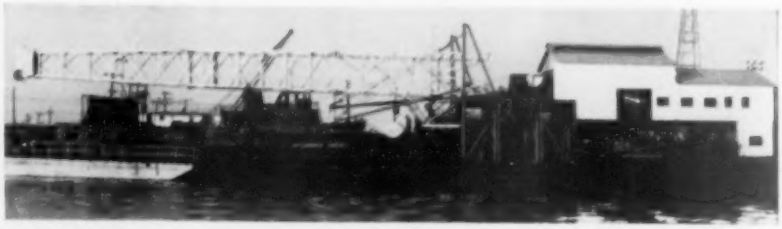
nounced the appointment of Horace Eugene Darnell as representative at Wichita Falls, Tex. Naming of Richard H. Dunbar as field representative at Russell, Kans., has been announced by Mark Barkhurst, Mid-Continent area manager.

Cook was employed in 1953 at Mission, Tex., and transferred to McAllen in 1955. Hooks joined Oilwell in 1952 at the division's Beaumont, Tex., store. Wiley was employed at the Harvey store in 1953, Reeves at the Fairfield store in 1948, Darnell at Wichita Falls in 1952, and Dumler at the Russell store in 1955.

Alexander Delivers Marshland Rig to Ward Drilling



Alexander Shipyard of New Orleans completed a first marshland drilling barge for Ward Drilling Co. of Baton Rouge. Ward ordered the 165-ft. marshland drill barge to enter the field of marshland drilling operations as the company has previously been engaged in dry-land drilling. Designed to drill a 13,000-ft. well, the unit went on its first location near Venice, La., on January 15. An unusual feature of this barge is that the derrick is raised and kicked over by means of two hydraulic jacks.

Caustic treaters, Shell Oil Company refinery, Anacortes, Washington

Partners in Petroleum

... to serve the expanding Pacific Northwest

SHELL OIL COMPANY refinery, recently completed at Anacortes, Washington, has a 50,000 barrel per day capacity. It is one of several new refineries built in the Pacific Northwest to serve an expanding economy.

Dependable, quality controlled chemicals assure greater refinery efficiency, increased production and aid in reducing costs. Numerous refineries throughout the United States and Canada are long-time users of PENNSALT quality controlled chemicals.

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Houdry Adds Clark to Sales Group, Chemical Division

John Robert Clark, Jr., of Bethesda, Md., has joined the sales organization of the chemicals division of Houdry Process Corp.

Clark had previously been with Washington Brick Co. at Muirkirk, Md., first as plant engineer and assistant to the president, and as plant manager just prior to joining Houdry.

Sulton Joins Wheatley As Sales Engineer

John Sulton, Jr., has joined Frank Wheatley Supply Co. as a sales engineer, according to an announcement by Huber Dye, vice president and general manager.

Sulton was formerly district sales manager of Nelson Electric Manufacturing Co., having been with them since 1950.

Mobile Units Serve Gulf Coast for Cleaver-Brooks

Operating out of the Houston and New Orleans area, Cleaver-Brooks mobile unit will provide service and parts for Cleaver-Brooks waste-heat and vapor-compression evaporators in the Gulf area. The mobile unit is completely equipped with spare parts. It is available night and day for service duty. A qualified Cleaver-Brooks service representative, Thomas Bishop, is on call at Houston. Both waste-heat and vapor-compression evaporators are used to provide fresh water required in offshore drilling operations in the Gulf.

National Makes Blair Mgr., Drilling Equipment Sales

J. S. BLAIR, JR.

The appointment of James S. Blair, Jr., as sales manager, drilling equipment, has been announced by The National Supply Co. Blair succeeds W. T. Cushing, who was appointed to the newly created position of manager of industrial sales.

Blair joined National Supply at its Jennings, La., store in 1941. Since 1947 he has been engaged in the company's export activities. In 1953 he was appointed district manager for eastern Venezuela, and in 1955 he was made manager of the company's Venezuelan subsidiary.

Bristol Co. Appoints Two New District Managers

The appointment of two new district managers has been announced by H. E. Beane, vice president of sales, for The Bristol Co., Waterbury, Conn.

L. B. LUMPKIN

W. C. PETERSON

L. B. Lumpkin has been named manager of the company's Pittsburgh office after spending 7 years as manager of the Brimingham office. W. C. Peterson will be taking over the managership of the Birmingham office.

Lumpkin joined Bristol's sales organization in 1937 in New York after working for National Aniline for 4 years. Peterson has been with Bristol's New York sales force 10 years. Prior to that, he was an instrument field service man for 6 years.

American Air Filter Names Engine-Compressor Manager

George C. Rodgers has been named manager of the engine and compressor department, American Air Filter Co., Inc., according to W. G. Frank, president. Rodgers succeeds the late Charles Sowerby who died last year.

Rodgers has been with the Herman Nelson Division of American Air Filter Co. for the past 5 years. For 5 years

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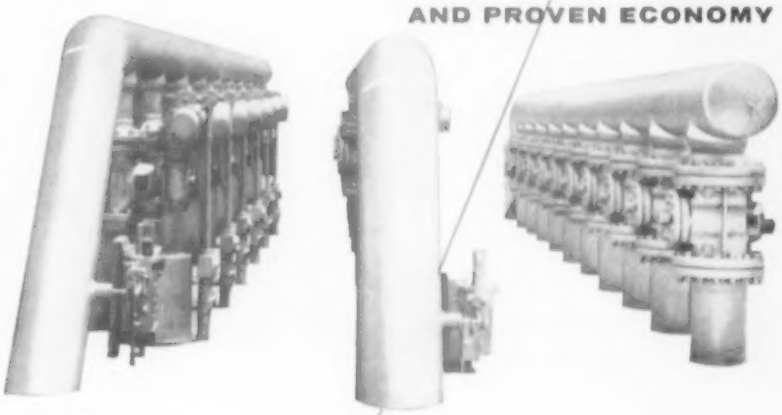

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With the perfection of its technique for regenerating heavy sludge acid, Consolidated has transformed an unwanted refinery by-product into a valuable raw material.

Now, *any* sulphuric acid sludge can be decomposed and used to produce new, water-white acid.

Consider the advantages this service offers: By contracting with Consolidated to regenerate your sludge . . . *you do away with the possibility of air or stream pollution . . . you save the initial investment in concentrators and separators . . . you spare yourself the trouble of operation and maintenance of this equipment . . . and you help conserve the nation's resources.*

Our plants at Houston and Baytown, Texas, produce 800 tons of high quality acid a day—solely from sludge. These facilities, and those at Baton Rouge, La., are served by barge, rail and truck. Regardless of where your refinery is located, Consolidated can help you.

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prior to joining Herman Nelson and American Air Filter, he was a representative for the Society of Automotive Engineers at the Bureau of Standards in Washington.

Clark Bros. Make Dobbins Regional Sales Manager

William E. Dobbins has been named central regional sales manager by Clark Brothers Co., Olean, N. Y., one of the Dresser Industries. In his new position, Dobbins will coordinate the activities of the Houston, Tulsa, and Chicago offices and will make his headquarters in Houston.

For the past 25 years, he has managed the Clark Brothers and Dresser Industries office in Washington. He also has been a special representative for Clark in the New York City area.

Continental of Canada Locates Store at Estevan

Estevan, Sask., Canada, is the location of a new store operated by Continental Supply Co., Ltd. J. B. Eyndhoven, formerly store manager at Continental's Virden, Man., store, will be the new store manager. The establishment of the Estevan store brings the total to nine stores and offices operated in Canada by Continental.

The Estevan branch will bring Continental customers greater convenience in the general area of southeastern Saskatchewan. This area will include the fields of Nottingham, Rosebank, and Alida to the east; Frobisher, Steelman, and Lampman to the northeast; and Midale and Weyburn to the northwest.

The Canadian company's headquarters in Calgary is headed by E. M. Fetzer, managing director.

I.P.M. Appoints Tracy Technical Representative

The appointment of Frederick F. (Ding) Tracy as technical representative has been announced by Internal Pipeline Maintenance Co., Odessa, Tex.

In 1948 Tracy joined Gulf Oil Corp. in the Permian basin where he served in various capacities as a production petroleum engineer. He was employed by Gulf at the McElroy field near Crane, Tex., at the time of his resignation to join I. P. M.

Weston Appoints Two To Key Sales Positions

The appointments of Russel A. Schlegel as manager of industrial product sales and John D. MacNamara as field sales manager of Weston Electrical Instrument Corp. has been announced by W. H. Steinkamp, vice president in charge of sales. Schlegel will assume responsibility for the sale of Weston industrial instruments in domestic markets.

Schlegel has had 19 years of experience in the sale and application of industrial instruments to major industries for the Brown Instrument Division of Minneapolis-Honeywell Regulator Co. Immediately prior to joining

R. A. SCHLEGEL

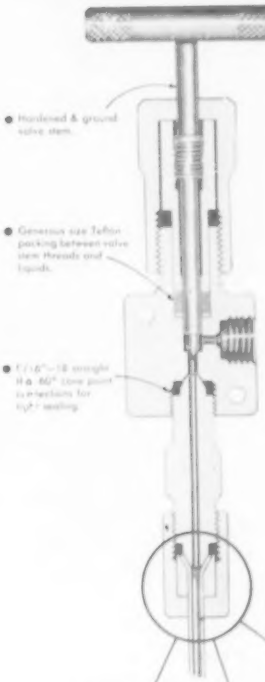
J. D. MacNAMARA

STANDARDIZE with ...

ONE
size valve

ONE
set of fittings for

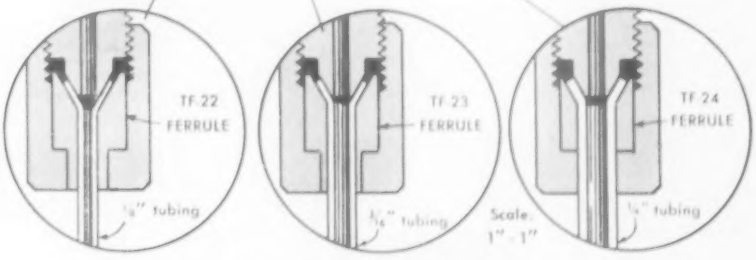
THREE
sizes of tubing—
1/8", 3/16" & 1/4"



INFERNO has STANDARDIZED valves and fittings for pressures up to 25,000 PSI, leading the way to greater savings for you. How? . . . . By letting ONE valve take the place of three. Up to now, changing from one size tubing to another meant changing valves and fittings completely. Now, Inferno offers a complete change from 1/8", 3/16" to 1/4" O.D. tubing with the help of a small ferrule. (See illustration)

Inferno also offers other valves and fittings for tubing up to 1/2" O.D. Write for Bulletin NO. 10

"IT'S ALL IN THE FERRULES"



Write for Bulletin No. 10.

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This plant is attacked constantly by corrosive smoke and fumes: it's attacked by coastal atmosphere that causes rust and corrosion; it's attacked by the heat of the sun. But aluminum paint protects against all of them.

Good aluminum paint actually puts a *protective shield* on rustable metal and masonry surfaces. It guards against deterioration. It retards evaporation of volatiles. It reduces heat expansion. It reflects heat and light to lower temperatures, make everything brighter.

Use aluminum paint inside your plant and out. Usually a single coat is all that's required. One coat lasts and lasts—you slash maintenance costs without sacrificing protection.

Reynolds Metals Company does not make aluminum paint. If you would like the names of manufacturers who rely on the high quality of Reynolds Aluminum Pigments, we'll gladly send you the list. Just use the coupon below.

Aluminum *Roof Paints and Coatings* Add Years to Roof Life

Asphalt-Aluminum roof paints and coatings provide low-cost, long-life protection for built-up and rustable metal roofs. Also reflect sun's heat to keep buildings up to 15° cooler in summer. Ask the paint salesman to show you his heat reflection demonstration. Insist on Asphalt-Aluminum roof paint or coating with this Warranty Seal. It assures you of an approved vehicle and at least two full pounds of pure aluminum pigment in every gallon.

The Finest Paints Made with Aluminum are made with REYNOLDS ALUMINUM PIGMENT

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Weston, he was responsible nationally for sales to the chemical and petroleum industries.

MacNamara has spent the last 10 years in sales work in connection with industrial, laboratory and scientific instruments. Following his employment with General Electric Co., he became an industrial division sales engineer and then industry sales manager of Minneapolis-Honeywell Regulator Co. Prior to joining Weston, he was industrial sales manager of Beckman Instruments, Inc.

Newton Is Sales Manager, White Diesel Engine

J. H. NEWTON

J. H. Newton has been appointed sales manager of the White Diesel Engine Division of White Motor Co., according to a recent announcement by W. F. Burrows, the division's general manager. Newton joined the Diesel Division sales activity in Springfield, Ohio, and prior to that he developed a broad background in diesel experience during 12 years with Fairbanks, Morse & Co.

DeWolf Becomes Sales Engineer for Granberg

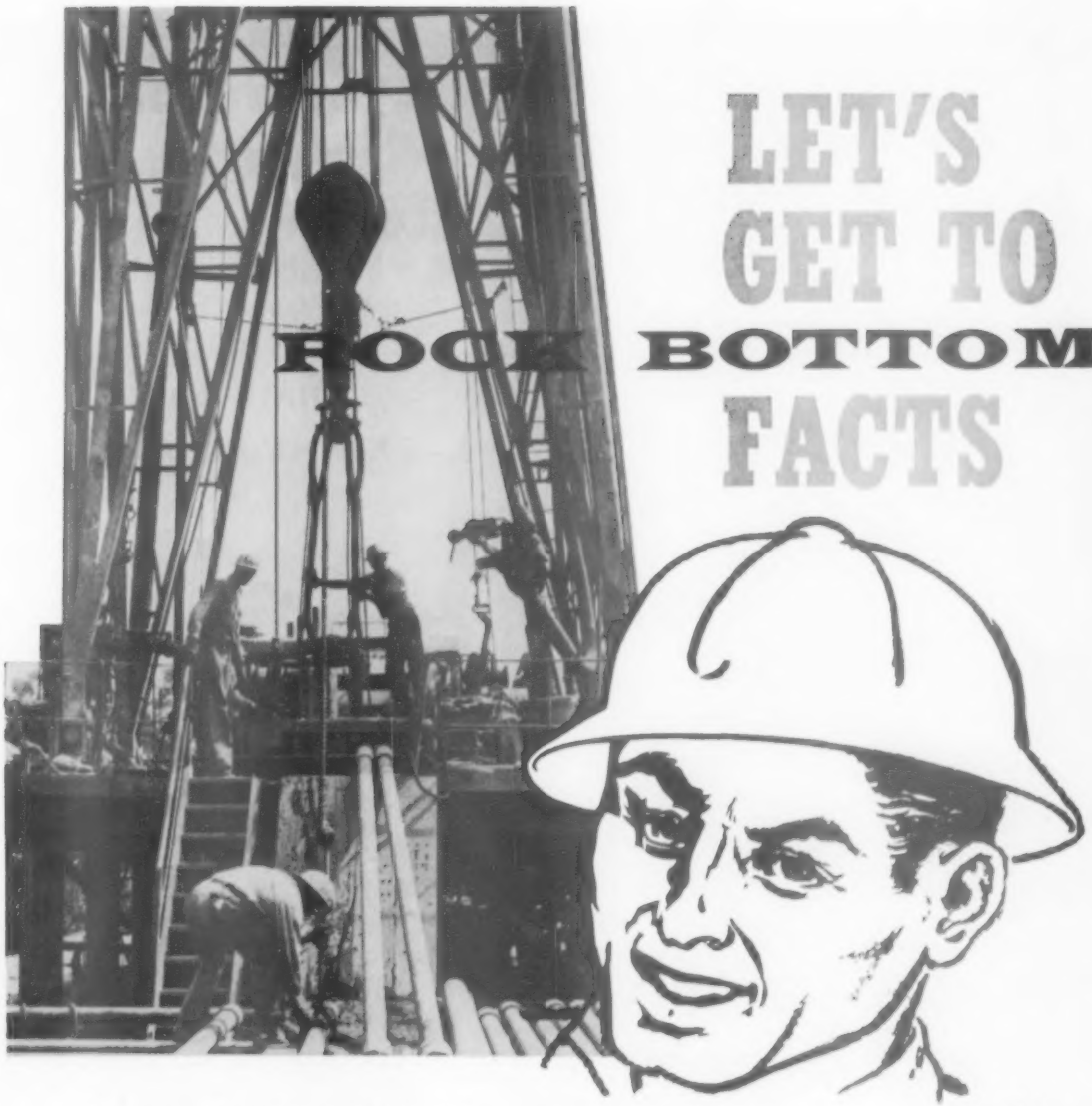
The appointment of Charles Franklin DeWolf as sales engineer has been announced by R. C. Anderson, vice president in charge of sales for Granberg Corp., Oakland, Calif. DeWolf's new duties will consist of coordinating engineering and sales-department functions for Granco's line of rotary pumps, meters, and accessories. He will work out of Granberg Corp.'s headquarters in Oakland.

DeWolf has had over 15 years' experience in design, engineering sales, and training of service personnel before joining the Granberg organization.

Totco Makes Robinson West Texas Field Representative

The appointment of Jack H. Robinson as a field representative in the West Texas area for Technical Oil Tool Corp. has been announced by H. H. (Pete) Peters, president.

Robinson, formerly of Hobbs, N. M., is making his headquarters in Odessa, Tex., where he will be under supervision of Ray Smith and Totco's West Texas division manager, Hugh Weathersby.



LET'S GET TO ROCK BOTTOM FACTS

On every rig, positive rock bit performance is a necessity. It means staying on bottom longer — digging more hole — helping to keep drilling costs at absolute minimum.

THE WORD FOR POSITIVE ROCK BIT PERFORMANCE IS — GLOBE!

Developed in the field, on actual jobs, under all digging conditions — engineered and manufactured to peak precision standards — Globe Rock Bits, prove daily, their superiority in digging talent! That's why more Globe Bits are being used wherever they're drilling for oil.

Globe "2-Cutter" Rock Bit Made in All Popular Sizes

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Prompt Service in All Principal Drilling Areas

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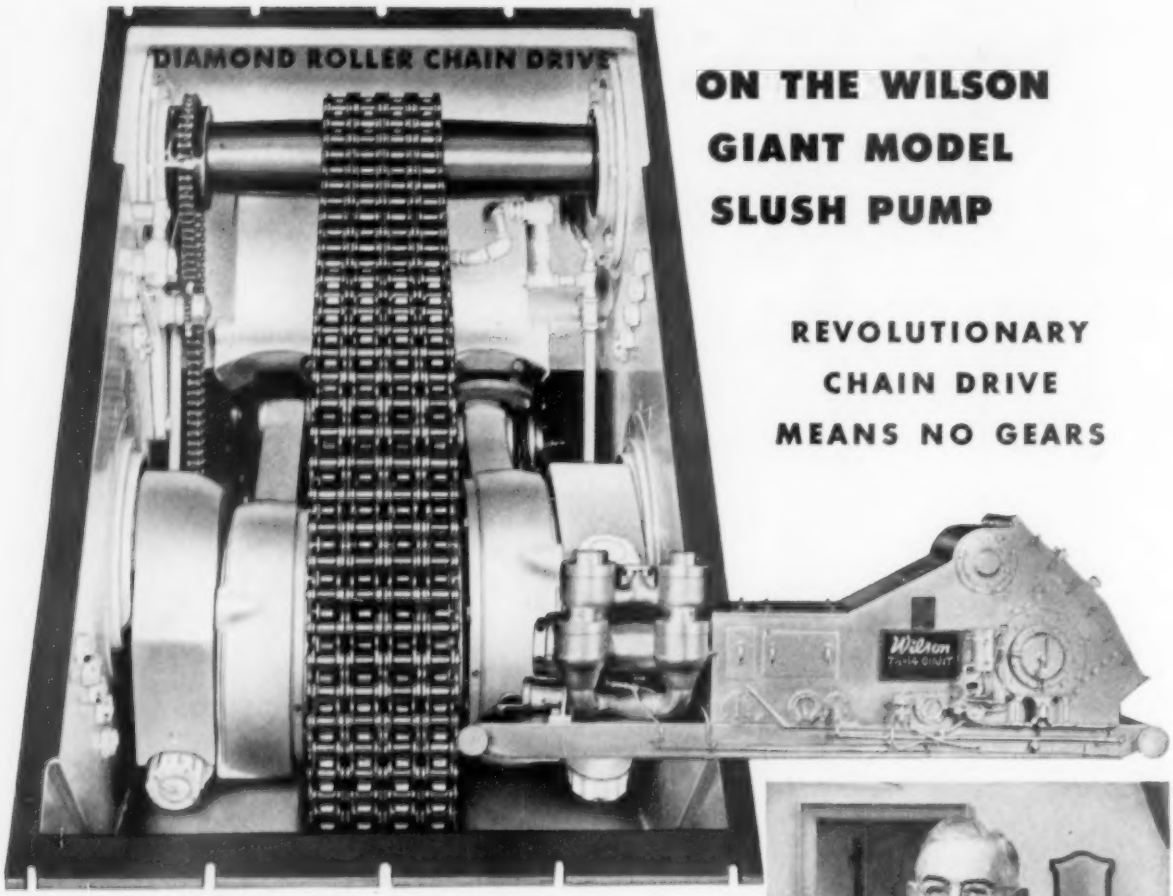
Globe Rock Bits Are Made in Regular & Integral Jet Models



Showing Diamond quadruple roller chain drive on Wilson Giant Model Slush Pump.

ON THE WILSON GIANT MODEL SLUSH PUMP

REVOLUTIONARY CHAIN DRIVE MEANS NO GEARS

MORE EFFICIENT-OPERATION WITH DIAMOND ROLLER CHAIN DRIVES

For this new slush pump, Wilson Manufacturing Co., Inc. have replaced gear drives with quadruple Diamond Roller Chains. This has added to the efficiency, has reduced weight and has eliminated damage often caused by gear tooth breakage. Smooth, non-slipping, long-life operation is assured in the handling of high volumes, pressures and capacities.

This is another example of successful Diamond Roller Chain application, good evidence of their continued preference ever since the early days of mechanized oil country machinery.

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DIAMOND ROLLER CHAINS

Puckett Points Way To Deep West Texas Exploration

by Frank J. Gardner

Gulf Oil Corp. has discovered the first Pennsylvanian oil pool on the large Puckett anticline in Pecos County, Texas. The well is expected to provide new exploratory impetus in the Delaware basin to the northwest.

A NEW era in West Texas exploration may have been heralded a couple of weeks ago at the well spotted on the map. There, Gulf Oil Corp. has reported oil flows on four successive drill-stem tests of the Pennsylvanian at depths of 10,114-92 ft. The discovery well is Gulf's 1-A Robbins Gas Unit, northernmost well to date in the deep Puckett gas field. Located in Section 35, Block 126, T&St.L. Survey, it opens the first oil pool for this prolific gas field, and is 20 miles from the nearest other oil field, Taylor-Link, also in Pecos County. It is 30 miles southeast of the nearest Delaware basin field at Fort Stockton, a Permian producer at 2,500 to 3,000 ft.

On tests conducted at end of February, the following data were reported:

Test 1: Duration 2 hours 20 minutes, depth 10,129-77 ft., gas surfaced in 5 minutes and oil in 1 hour and 20 minutes; well flowed 40 bbl. 42.8° oil in 1 hour.

Test 2: Duration 3 hours 15 minutes, depth 10,129-92 ft., gas surfaced in 5 minutes and oil in 2 hours 45 minutes, cleaned to pits 15 minutes, flowed 30 minutes and packer failed. Oil flow was 13.79 bbl. with gas-oil ratio 982:1, no water.

Test 3: Duration 5 hours 15 minutes, depth 10,136-92 ft., gas surfaced in 5 minutes and oil in 3 hours 10 minutes. Cleaned to pits 5 minutes and turned to tanks for 2 hours; flow was 33.78 bbl. oil, gas-oil ratio 982:1.

Test 4: Duration unreported, depth 10,114-92 ft., 5/8-in. chokes, gas surfaced in 1 hour, 2,000-ft. water blanket and mud to surface in 3 hours 15 minutes, cleaned to pits 20 minutes; flowed 154.15 bbl. oil in 10 hours on 1/4-in. choke, 99.29 bbl. in 4 1/2 hours on 1/2-in. choke, gravity 42.8°.

The first oil . . . Gulf now has carried the hole to 10,383 ft. and set 7 5/8-in. casing there. It is a 15,000-ft. Ellenburger contract, and operators will probably continue to that depth. Final completion as a Pennsylvanian oiler would mark the first oil success for Puckett. In March 1954 Phillips Petroleum Co. had a Pennsylvanian gasser at its 1-H Puckett, on the west flank of the field at 13,218-30 ft., but it has now been abandoned. Several wells on the northeast flank have indicated gas production from the Siluro-Devonian section, but to date all production has been Ellenburger gas at the 13,000-15,000-ft. level.

On a great structure . . . Puckett[1] is a great anticlinal structure 3 miles wide (southwest-northeast), and perhaps 8 miles long (northwest-southeast), though it is yet undefined to the northwest. Structural relief approaches 2,800 ft., and a major fault terminates the structure on the west. It is currently producing about 40 million cubic feet of gas per day from 14 Ellenburger wells. The gas is low B.t.u., high CO_2 content, and is processed by Permian Basin Pipeline Co.'s plant, where the CO_2 is removed before the gas enters the pipeline to market. This plant, incidentally, is marked for enlargement in 1956 from present capacity of 25 million cubic feet per day to 105 million cubic feet—a reflection of the confidence of field operators in the future of the field.

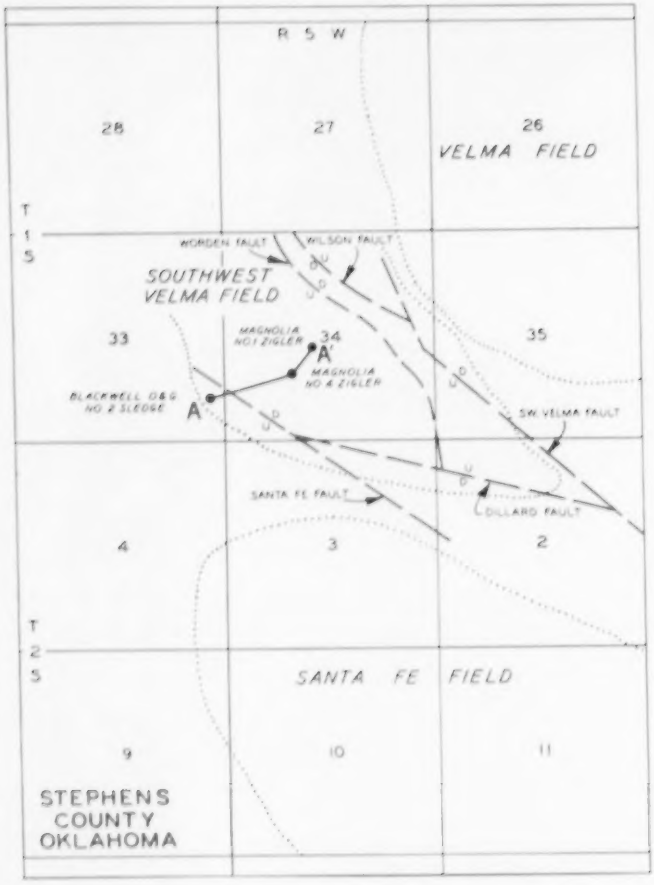
Is a milestone . . . This new discovery of deep Pennsylvanian oil is an exploration milestone. It lies in the Sheffield channel, an ancient seaway that is believed to have connected the Delaware and Midland basins. It is a new "go" signal to West Texas operators who for years have sought deep pre-Permian oil throughout the Delaware basin.

Several noncommercial oil fields have been discovered in the deep basin, and two good gas fields (Toyah and Bell Lake) from pre-Permian beds. But the firm conviction of geologists that this vast 6,000,000-acre basin harbors deep pools has not yet been substantiated. The presence of shallow Permian fields throughout the basin (see map), plus showings and noncommercial flows in some of the few deep tests that have been drilled, provide evidence that the conviction must be true. Deep drilling there has been at a disadvantage because a great thickness of Permian beds masks the deeper formations and geophysics has been hard put to spot structure. As progress is made in the newer techniques and methods employed by today's seismic crews, this problem should resolve itself, and the Delaware basin's deep oil will be uncovered. It is perhaps the most hopeful geologic province in Texas today for major pools.

Toward a new discovery cycle . . . The discovery of Pennsylvanian oil at Puckett has struck a spark of optimism. If deep oil can now be found to the west, in the depths of the Delaware, West Texas will be afire with another of its famous "cycles of discovery."

Reference

1. "Puckett Field Opens New Vistas in West Texas," Norman S. Morrisey, The Oil and Gas Journal, November 8, 1954, pp. 244-248.



Simplified map shows the main faults in the Velma area of Stephens County, Oklahoma. Production from the Blackwell Oil & Gas Co. 2 Sledge is from the Springer sands. Fig. 1.

Index map of southern Oklahoma shows relationship of Southwest Velma field and other important producing fields. Fig. 2.

Southwest Velma Stepout Scores

by Bill O. Andress

NEW discovery possibilities await Oklahoma operators equipped with active imaginations. That's what is suggested by recently discovered evidence of reverse or thrust-faulting west of Southwest Velma field, Stephens County, Oklahoma.

The Blackwell Oil & Gas Co. of Tulsa is now completing the 2 Sledge located in the NE SE SE 33-1s-5w (Fig. 1).

Initial potential gages from two fracture-treated Springer sands (lower Pennsylvanian) yielded 104 bbl. of oil per day flowing through open tubing from perforations at 6,448-64 ft., and 75 bbl. of oil per day swabbing through perforations at 6,943-53 ft. Gravity of oil is 37°. Gas-oil ratio is negligible.

Location . . . Southwest Velma field is located in east-central Stephens County. It produces in Sections 28, 33, 34, and 35-1s-5w, and Sections 2, and 3-2s-5w.

The attached pool index map (Fig. 2) reveals this field to be contiguous with Santa Fe field immediately to the south. However, these pools are in separate geological locales distinguishable in subsurface by two pronounced WNW-ESE trending faults* termed the Dillard and the Santa Fe faults (Fig. 1). This fault map presents more clearly the pattern of faulting as interpreted from well records. Positioning of faults as shown represent the intersection of the fault plane with the Springer unconformity.

With respect to maximum ultimate recovery, the Springer formation is now the most important producing horizon. Sandstones within this formation are reasonably correlative over large areas, although considerable thickness and facies variations are observed.

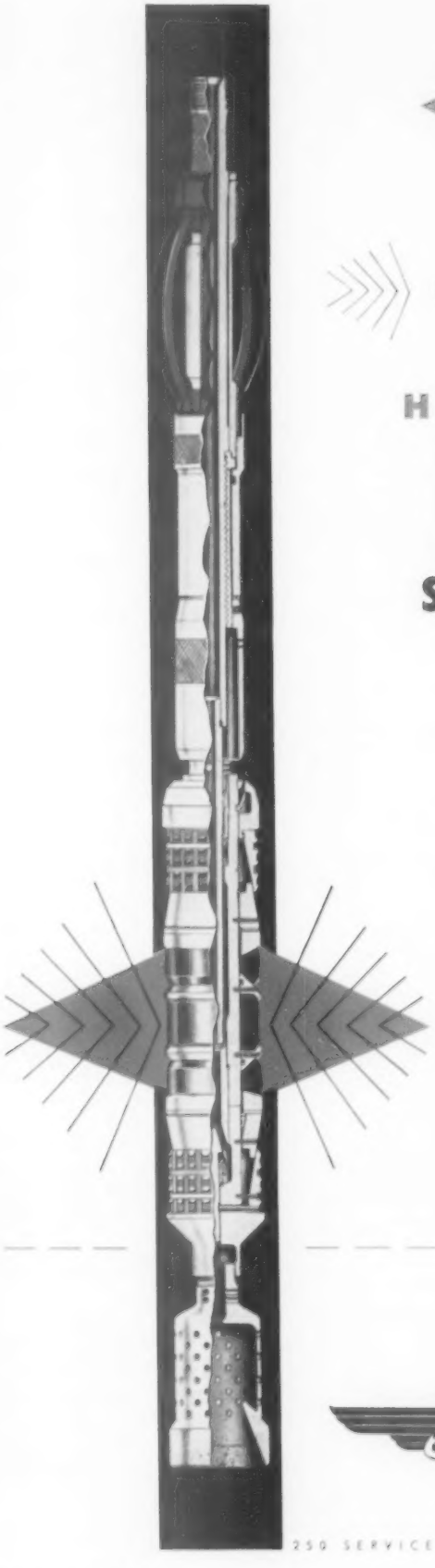
The Deese formation offers shallower Pennsylvanian merit, but erratic sand conditions make predictions useless.

Springer-Aldridge sand . . . Southwest Velma field produces from the Aldridge sand in 11 wells west of the Worden fault and in 2 wells on the east side. The Aldridge sand is the first sand below the Springer unconformity at Southwest Velma.

The Markham sand, a unit strati-

Author is geologist for Blackwell Oil & Gas Co., Tulsa.

*For a detailed understanding of the area, see a copy of the recently published symposium, "Petroleum Geology in Southern Oklahoma." Sponsored by the Ardmore Geological Society, it has been published by the American Association of Petroleum Geologists. Included in this volume is a paper, "Geology of the Southwest Velma Field, Stephens County, Oklahoma," by I. Curtis Hicks, Phillips Petroleum Co., Bartlesville. This paper vividly illustrates some of the structural conditions that reverse faulting has produced in this field.



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Both the DM Packer, made of drillable magnesium alloy for a tight temporary plug, and the DC Packer, made of drillable cast iron for a tight permanent plug, have improvements designed to permit precise control of squeezing and bridging in holes of any depth, to give maximum protection against casing or tubing failure, to reduce swabbing action running in or out of hole, and to impart positive sealing qualities.

The simplified setting operation – a mechanical rotation of tubing to the right – is typical of the engineered advantages that make perfect runs possible time after time. You get the rugged dependability you need when you order a Halliburton DM or DC Squeeze Packer. It's a precision tool developed by the world's most experienced cementers.

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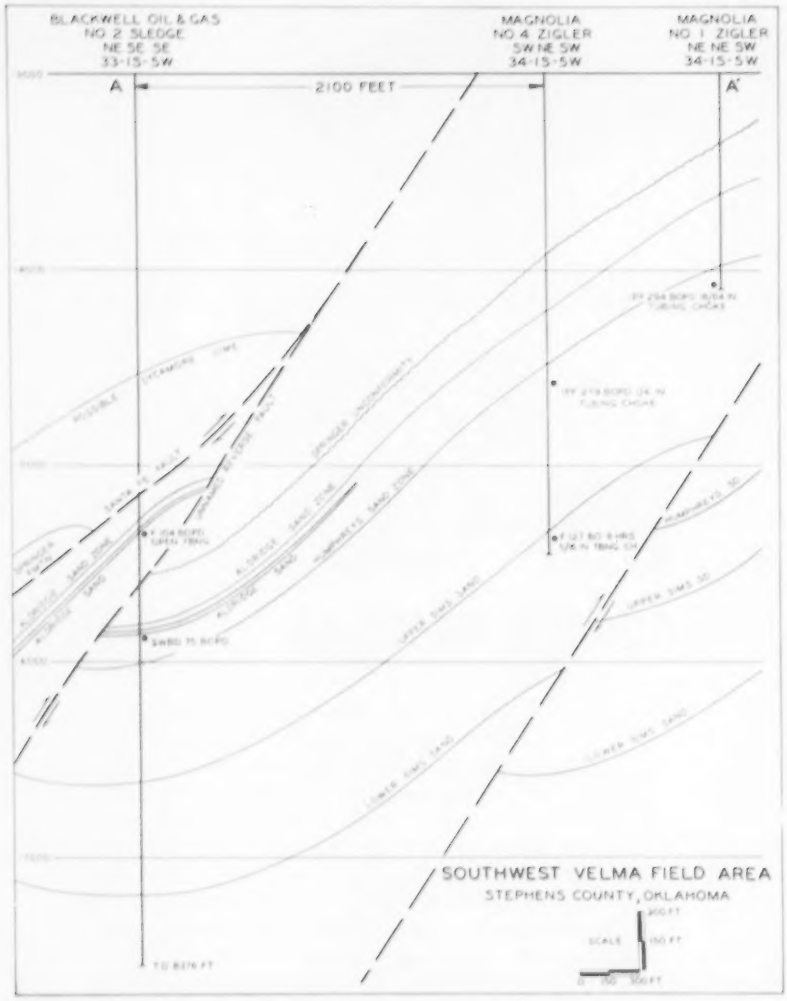

Preliminary cross section A-A' reveals that production is related to both folding and thrust faulting. Fig. 4.

graphically higher in the Springer formation and also found elsewhere, is believed to have been removed by erosion.

The Aldridge sand contains salt water in the vicinity of the SW¼ and in a portion of the NW¼ of 34-1s-5w. This sand zone was encountered at 6,380 ft. in the 2 Sledge and again at 6,900 ft. It is believed that, prior to reverse faulting, these units were connected and equivalent to the Aldridge sand encountered in the Magnolia Petroleum Co. 4 Zigler. These zones are not producing in the 2 Sledge.

About 60 and 30 ft. respectively below each of the above sand zones, productive oil sands were found. These also were probably continuous prior to faulting, but they are considered as not having been encountered previously to the east. The varying sand thicknesses and interval thicknesses between units are attributed to greater dip within the upthrown block (about 45°) and lesser dip within the downthrown side (about 10°-15°). Differential dip between fault blocks is probably due to fault drag as shown in Fig. 4.

Humphreys sand . . . The Humphreys sand produces oil from 20 wells on the west side of the Worden fault and from 6 wells on the east side.

The Humphreys sand zone in the 2 Sledge was encountered from 7,102 to 7,500 ft. Sample analysis reveals that this sand zone consists of alternating intervals of (1) thin, tight calcareous sands, (2) shaly sands, and (3) some quartzitic sands. Considerable glauconite was reported in addition to several thin oolitic limestone stringers. A

Pay sands in 2 Sledge occur in the Springer formation. Notice that the Aldridge zone is repeated. Fig. 3.

drill-stem test of the most favorable upper portion yield no shows.

Sims sand . . . The Sims sandstone zone in Southwest Velma field consists of two sand units, the uppermost of which produces in several wells on both sides of the Worden fault. The lower sand unit is highly erratic.

The 2 Sledge encountered upper Sims sand zone at 1,716 ft. and the lower Sims sand zone at 8,286 ft. The upper unit contains an abundance of alternating thin quartzitic sand stringers and sandy well-developed oolitic limestones. None of the sandstones possesses better than very slight porosity. Some staining and fluorescence was noted.

The lower unit consists of fine, tight, calcareous sand and fine, medium-hard, silty and shaly calcareous sand. MicroLog indicates about 4 ft. of broken permeability from 8,292 to 8,293 ft., and from 8,295 to 8,298 ft. A sand-fracture attempt through perforated 7-in. casing opposite zones of indicated permeability resulted in incomplete load oil recovery.

The 2 Sledge was bottomed at 8,672 ft. and 7-in. casing was cemented at 8,376 ft. with 1,000 sacks. Following the unsuccessful lower Sims fracture attempt, the well was plugged back to 7,000 ft. and completed as previously mentioned. The Oklahoma Corporation Commission is presently considering a dual-completion request.

Structure . . . The prime factor governing structure in Southwest Velma is reverse or thrust faulting. In addition to the major NW-SE trending reverse faults, it is believed that many less-distinguishable adjustment and cross-faults are present.

Major faulting began during early Pennsylvanian time and ended during post-Hoxbar pre-Permian time. Differential settling coupled with large compressional forces created curved fault planes, adjusted faults, and crossfaults.

Between the 2 Sledge and the Southwest Velma fault, perplexing production problems exist (such as inverted oil-water relationship). Without suggesting complex sedimentation possibilities, these localized gravity paradoxes are more reasonably explained by minor adjustment and crossfaults. However, due to severe west regional dip (4,000 ft. per mile), structural mapping of faults possessing less than 100-ft. vertical displacement is extremely difficult.

Background . . . Prior to drilling the 2 Sledge, Springer sand exploration west and southwest of the SW¼ 34-1s-5w was postponed. This was due, in part, to geological supposition that Springer productivity was limited because of postulated severe low-angle thrust faulting. Mississippian sediments would thus be found immediately overlying the Springer formation.

Indications of Springer sand thinning from Southwest Velma westward (and possibly unfavorable sand development in that direction) further retarded the drilling of flank tests. Mississippian limestone thickness was expected to be considerably increased due to possible steep dip within the upthrown block. This fact, together with the depth considered necessary to penetrate the thrust plane, suggested prohibitive drilling costs.

The presence of this huge thrust fault (termed the Santa Fe fault and estimated to possess from 3,000 to 5,000 ft. of vertical displacement) had been postulated upon premises considered questionable by many southern Oklahoma operators. Due to the absence of definite subsurface geological data, the 2 Sledge was scheduled for a Springer test.

Following Deese penetration, supposedly Dornick Hills sediments (as indicated by electrical log and sample data) prove uncorrelative with nearby wells. Throughout the interval from 3,053 to 5,676 ft., well cuttings reveal similarity to other sediments ranging from typical Dornick Hills shales down to and including Mississippian Caney shale.

At 5,676 ft., a 650-ft.-thick whitish-gray to light-brown finely crystalline sandy limestone was encountered (Fig. 3). This unit is considered to be Sycamore limestone (Mississippian). Very light staining and fluorescence, accompanying minute porosity laminations, are noted. Drill-stem test and MicroLog data indicate this unit to be impermeable. The presence of this limestone strongly suggests a large displacement thrust fault which is believed to be the Santa Fe fault (Fig. 4).

It is worthy to note that many factors are in favor of the low-angle, large-displacement thrust fault. However, several factors oppose this theory. Some of these are:

1. Caney shale sediments in areas of maximum depositional environment rarely exceed 400 ft. in thickness. With low-angle dip an 1,100-ft. section defies conception.

2. Sycamore limestone samples indicate a possibly redeposited sediment. However, such thickness (650 ft.) may be readily explained as a massive limestone distorted by fault drag.

3. Sediments between the base of the Deese formation and the top of the Sycamore limestone reveal considerable admixtures of various types of shales dissimilar to formations expected to occur within the upthrown fault block above the Sycamore lime.

Many opinions have been expressed regarding each possibility. But, it is believed that data obtained from this test cannot alone explain structural and lithologic problems. Additional information obtained by drilling will help prove which, if either, of these conditions exist.

It is presently impossible to predict the westward limit of the uppermost productive Springer sand encountered in the No. 2 Sledge. Doubtless, post-Springer erosion and truncation by younger beds farther southwest must be considered. Nearness to the northeastern edge of the Central Wichita uplift precludes optimistic supposition

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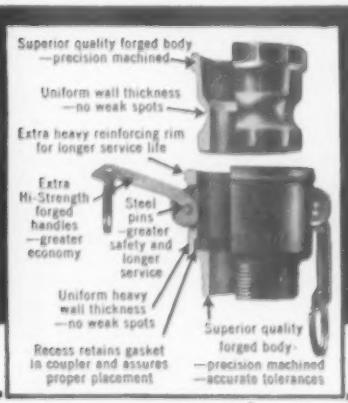
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southwest of a line diagonally bisecting Township 2s-5w from the northwest corner to the southeast corner of that township.

Provided that favorable sand conditions extend to this boundary, possibilities of additional reverse faulting will continue to attract operators to this area of 10-acre "wildcat" offsets.

Acknowledgment . . . The author wishes to express his gratitude to those individuals who contributed their knowledge and time toward presenting a better understanding of geologic problems in southern Oklahoma.

Special gratitude is expressed for the cooperation offered by Jim Jones, consulting geologist, Duncan, Okla.

EXPLORATION HIGHLIGHTS

WESTERN CANADA

ALBERTA

Oil Recovered From Dunvegan at Simonette River

Richfield Oil Corp., Cities Service Petroleum Corp. and Sinclair Oil of Canada, Ltd.'s joint venture in the Simonette River area of northwest Alberta has encountered oil during a drill-stem test run in the Dunvegan zone of the Lower Cretaceous formation. The new strike, which yielded a recovery of 900 ft. of medium-gravity oil during that drill-stem test, lies 55 miles southwest of Grande Prairie town and is about 200 miles west-northwest of Edmonton city limits.

The well, Richfield-Cities Service-Sinclair 1 Simonette, on LSD 3, 7-63-2w6, is 24 miles southeast of the teams' 1 Smoky River abandonment.

This discovery was registered during a drill-stem test run around the 7,300-

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ft. level and also flowed gas to the surface at a rate of 25,000 cu. ft. daily.

Success Recorded at Joffre West Field

The team of Bailey-Selburn Oil & Gas, Ltd., Crowsnest Pass Gas & Oil Co. and Conick Petroleums, Ltd., has scored success at an extension venture in the Joffre West (Burbank oil pool) area of central Alberta, midway between that oil area and the main Joffre field. The current success, Baysel-Crowsnest-Conick 9-12 Burbank, situated 1⅛ miles southeast of the team's 1-14 oil success in the pool, flowed oil to the surface during initial test and indicated a Viking pay thickness of 26.5 ft., on basis of cores from 4,960 to 5,001 ft.

This well, 9-12 Burbank, is on LSD 9, 12-39-27w4, covered a 20-ft. interval on this drill-stem test, oil flowed to the surface in 21 minutes and gas was registered at the rate of 350,000 cu. ft. daily. The recovery was pumped out of the pipe.

Cardium Discovery Reported At Crimson Lake Wildcat

Great Plains Development Co. of Canada, Ltd., operator of an exploratory test in the Crimson Lake area of central Alberta reported the discovery of condensate-bearing natural gas in the Cardium sand at the wildcat venture. During a drill-stem test in the Cardium horizon a maximum gas flow rate of 5.2 million cubic feet daily was recorded and the same test yielded a recovery of yellow-green distillate when pipe was pulled.

This well, Great Plains-Triad 9-23A Crimson Lake, LSD 9, 23-40-9w5, is 12 miles northwest of Rocky Mountain House town and 7½ miles northwest of the Ferrier area Viking oil pool while the Southern Producation-Can. Atlantic 14-27 Ferrior, dry hole lies 6¾ miles southeast.

The drill-stem test was run around the 7,600-ft. mark and actual recovery consisted of 210 ft. of distillate and 180 ft. of distillate and mud emulsion. Crew was continuing to drill ahead at last report.

Confirmation Reported at Harmattan Discovery

Home Oil Co., Ltd., reported this week that its follow-up well to the company's oil discovery venture in the Harmattan area of central Alberta has indicated oil success during the initial test run in the Mississippian, discovery horizon. The new indicated well Home Oil-C & E 9-7 Harmattan, is located ½ mile north of the 1-7 Harmattan discovery well and the company reported that another Home operated well ⅜ of a mile southeast of that discovery should find its answer shortly.

The 9-7 Harmattan success was drilled on LSD 9, 7-32-4w5 to a total depth of 9,200 ft. and during the drill-stem test, just above total depth, 7,575 ft. of gas-cut oil, gassy oil-cut mud and clean oil was recovered.

The company also stated that its discovery well 1-7 Harmattan, has been producing at its allowable rate of 320 bbl. per day since being put on production early in January.

PACIFIC COAST

CALIFORNIA

Richfield Scores New Wheeler Ridge Field Find

Richfield Oil Corp. completed the 9,213 ft. 52-36 KCL F for a new field discovery 2 miles southeast of Wheeler Ridge field in southern Kern County.

Initial production from the Lower Miocene sand zone was 149 bbl. daily of 41.5°-gravity crude through a 48/64-in. choke. This wildcat was plugged

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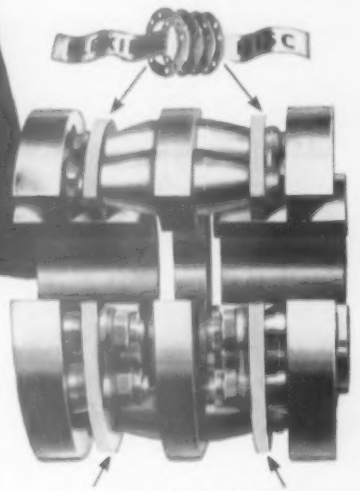

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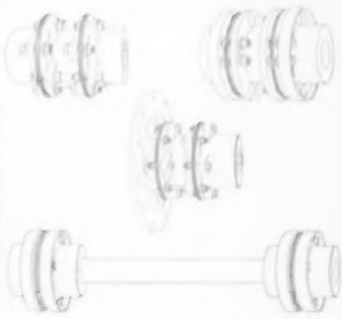

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back to 8,950 ft. before liner and tubing was run for the completion.

Production in the main field to the west is from both Miocene formations and a prolific Eocene formation. Richfield will probably test the Eocene with its first offset to the latest discovery well. Three other companies besides Richfield hold offsetting acreage in the area.

Union Completes First Oil Creek Offset

Union Oil Co.'s first offset in Oil Creek field, southern San Mateo County, was completed in 473 ft. of new zone as compared to 146 ft. of zone found in the discovery well.

The first offset, 2 Costa, is located 660-ft. northwest of the discovery. It was completed on pump for initial production from the Costa sand of 30 bbl. daily of 42.2°-gravity crude and 500 M.c.f. of gas. The perforated interval is 1,915-2,000 ft.

Union had to redrill this offset after missing the discovery well pay zone. The company plugged back from 3,476 ft. and redrilled to 2,600 ft. It was then plugged back again, this time to 2,502 ft. for the completion.

Union will spud in the second offset immediately from the same drill site used for Costa 2. This second offset will bottom 660-ft. northwest of the drill site.

West Montalvo Field Production Extended

Production in West Montalvo field, Ventura County, was extended ½ mile east with the completion of Sunray Mid-Continent Oil Co. 1 Sunray-Ohio-Katsuda-Leonard.

The perforated zone in this 14,819 ft. extension test is at 14,350-14,817 ft. Initial production was 411 bbl. daily of 30.5°-gravity crude through a 20/64-in. choke. Production is coming from a lower Sespe sand.

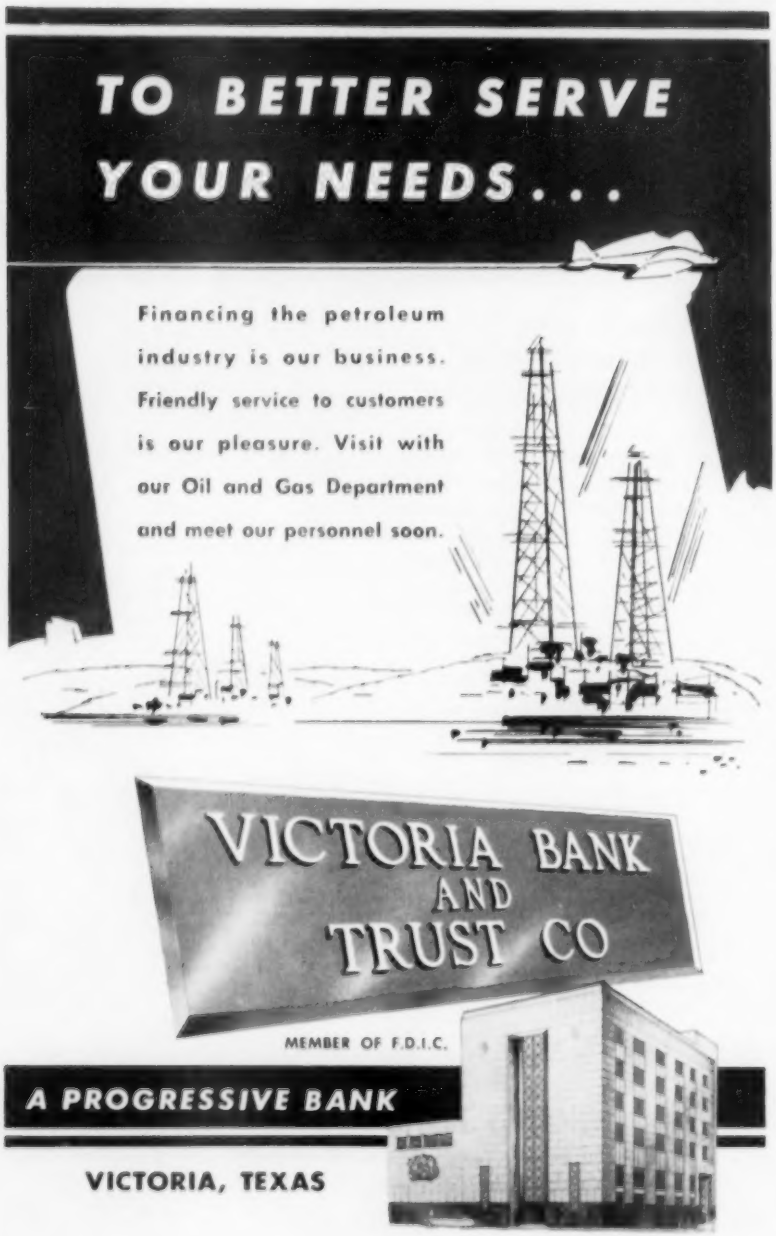
Sunray and the Ohio Oil Co., with Sunray acting as operator, jointly share a 2,300 acre lease in this area.

Santa Fe Springs Suffers Setback

The latest drilling boom at Santa Fe Springs in Los Angeles County suffered its first setback when Rothschild Oil Co. 1 Monte, located less than ½ mile southwest of General Petroleum Corp.'s new deep zone discovery, tested wet.

Rothschild redrilled 1 Monte from 7,850 ft., where it was originally completed in the Clark-Hathaway zone, to 9,077 ft. before suspending operations. GP's discovery, 243 Santa Fe, found the new Santa Fe zone at 8,050-9,010 ft.

About ½ mile southeast of 243 Santa Fe, Rothschild's other redrilled test aimed for the new zone is also reported to have tested wet. However, the operator has landed 5½-in. casing, with 388 ft. of perforations, on the bottom at 9,085 ft. Rothschild is considering gun perforating the middle Santa Fe zone.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EAST TEXAS

Drilling Play Develops in Northern Titus County

Northern Titus County was in line for a deep drilling program, in the area of Stephens and Peveto's Paluxy oil and Rodessa gas discovery. See The Oil and Gas Journal, January 9, page 69 for a map showing location of the discovery, 1 Fla Lewis, in relation to Talco field, and the Talco and Sulphur River fault zones.

Two new projects, both wildcats, have been announced by R. E. Moore, Omaha, and W. M. Coats, Longview, and E. B. Germany & Sons, Dallas.

Moore and Coats will drill their 1

Hoffman to 7,000 ft., 7 miles northeast of Talco townsite. Location is in the BBB&C RR Survey, A-74, which falls about ½ mile south of the Sulphur River, and 2 miles east of the discovery.

E. B. Germany 1 Roy Gentrey is located 8 miles east of Talco and 2½ miles northwest of production in Pewitt Ranch field. Projected depth was 6,500 ft. Location is in the SA&MG RR Survey, A-546.

No. 1 Fla Lewis found Paluxy oil at 4,702-14 ft., and gas distillate in the Rodessa at 6,449-54 ft.

Franklin County wildcat . . . J. A. Lavender, Jr., Dallas, was reported planning a wildcat just west of the Titus County discovery, but across the line into Franklin County. Unconfirmed location was on a 160-acre tract in S. E. Henry Survey, A-628, which is east of Terry Lake, and north of Hagansport.

First Oiler at Barnett

New pay in Rusk County . . . First oil completion for Barnett-Woodbine field 6 miles south of Price has been reported at Roy G. Woods 2 Kangerga Brothers, R. A. Allen Survey. Potential was 82 bbl. of oil a day through ⅜-in. choke, from pay at 3,731-34 ft. Oil was 29.6°, and gas-oil ratio was 16,630:1.

The new pay opener is a long southeast offset to Sinclair Oil & Gas Co. 1 Alsup, which opened the gas area from pay at 3,760-66 ft.

NORTH LOUISIANA

New Paluxy Well Finaled In Bethany-Longstreet Field

The Bethany-Longstreet area of Caddo Parish in Northwest Louisiana has a new Paluxy area. The discovery well is Jones-O'Brien, Inc., 2 Keatchie Investment Corp. in SE¼ 11-14n-16w.

The well flowed at the rate of 135 bbl. of 38.6°-gravity oil daily on 3/16-in. choke from Palusky perforations at 3,066-69 ft.

February Summary of Wildcat Activity

New pays and extensions featured North Louisiana exploratory activity in February. There were no new fields opened.

Scooter's Drilling Co. 1 Stevenson in SW SW 16-13n-14w, is a new pay for the DeSoto Parish portion of Bethany-Longstreet field. The well flowed 209 bbl. of oil per day from perforations in the Paluxy at 2,933½-36½ ft. This new well is at the extreme southeast end of Pettet production in the Bethany-Longstreet field area.

Williams Drilling Co. et al 1 Boucher in C NE NE SE 17-23n-11w, Southwest Springhill field, Webster Parish, pumped 76 bbl. of oil per day from Tokio at 3,088-89 and 3,091-97½ ft.

Trans-Tex Drilling Co. extended Pine Island field in Caddo Parish 2 miles northeast. The well is the 1 Caddo Levee Board, 8-22n-15w. The well flowed at the rate of 156 bbl. of 41°-gravity oil per day on ¼-in. choke from perforations at 2,642-54 ft. in the Paluxy. The well has since been confirmed with new locations announced in the immediate discovery area.

BASIN AND RANGE

NEVADA

Shell Fails on Nevada Wildcat

Shell Oil Co. was preparing to abandon 17-34 Eagle Springs, a wildcat located about 1 mile west of Shell's Railroad Valley production in Nye County, Nevada. Shell tried to get a

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drill-stem test on this 9,518 ft. wildcat but the packers failed.

ROCKY MOUNTAIN

NORTHWEST NEW MEXICO

Pennsylvanian Cored at Humble Paradox Wildcat

Humble Oil & Refining Co. is coring below 5,738 ft. in the Pennsylvanian at the 1-B Navajo, C NW SW 29-32n-20w, San Juan County. This northwestern New Mexico discovery project is located on the southeast rim of the Paradox basin.

Recovery on a drill-stem test at 5,606-26 ft. was 3,203 ft. of oil, highly gas cut. A test at 5,653-72 ft. got 300 ft. of heavily oil and gas-cut mud. The first drill-stem test at the well, at 5,539-5,606 ft., flowed 28 bbl. of oil in the first hour, 21 in the second, and 20 in the third.

MONTANA

Amsden Flows Oil at Wolf Springs Well

Carter Oil Co.'s 2 Horton in C SE NW 29-7n-32e, South Wolf Springs, Yellowstone County, flowed oil on a drill-stem test on the Amsden at 6,158-6,227 ft. Completion is due.

This is the second test at South Wolf Springs. The 2 Horton is a 160-acre northwest offset to the discovery well in C SE SE 29-7n-32e, 1¾ miles southeast of Wolf Springs field.

UTAH

Gas Flow Reported At Grand County Well

A Grand County gas discovery flowed at the rate of 1,993 M.c.f. per day from 5,860-6,020 ft. in the Dakota sand. Sinclair Oil & Gas Co. 2 San Arroyo Unit in SE SE NW 22-16s-25e, is drilling below 6,032 ft. This new discovery is 1½ miles northwest of the discovery well at San Arroyo. Sinclair completed that well for 18,500 M.c.f. per day from the Entrada.

EASTERN INTERIOR

ILLINOIS

One New Oil Pool in Illinois in February

One new oil pool, Oakdale in Jefferson County, was discovered in Illinois in February, according to the State Geological Survey Division of the Department of Registration and Education.

The February Drilling Report also reports two new extensions, both to the Cooks Mills Consolidated pool. One was an oil well in Coles County and the other a gas well in Douglas County. In the Irvington pool, the first Trenton limestone well was completed.

During the last half of February, the number of new wells completed per week dropped to not much more than half the weekly average for the preceding 3 or 4 months. Drilling operations always show a seasonal drop in the spring when road conditions make movement of oil-field equipment difficult or impossible. The number of wells completed in February was below that of February 1 year ago, but above that for 2 years ago.

Total number of completions for February was 191 wells, including 95 oil wells and 3 gas wells. All three gas wells are in the Cooks Mills Consolidated pool.

Crude-oil production for February was estimated at 6,620,000 bbl., or about 228,000 bbl. per day; January production was estimated at 231,000 bbl. per day. This 3,000 bbl. per day decrease is less than might have been anticipated in relation to the decrease in drilling.

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The Cooks Mill area in Coles and Douglas counties, where both oil and gas wells are being completed, remains one of the most interesting developments among the smaller oil pools in the state. In Saline County, the Harco pool, discovered in 1954, had only four producing wells completed to the first of February. Four more were completed in February, and four were drilling at the end of the month. This may be the beginning of another good pool development.

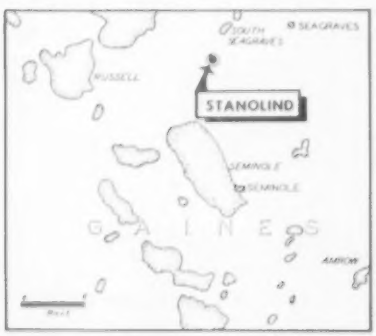
WEST TEXAS-NEW MEXICO

WEST TEXAS

Gaines County Wildcat Flows Strawn Oil

Stanolind Oil & Gas Co. 1-E Oil Development Co., north of Seminole, has made two flows of oil at this writing, and was drilling ahead, with the Devonian as the objective.

Operators drilled into the Strawn pay at 11,213 ft., minus 7,795 ft. Drill-stem test from 11,200-49 ft. had flowing oil in 4 hours, making 16 bbl. in 1 hour



Stanolind 1-E Oil Development Co. found Strawn oil while drilling to the Devonian.

and 20 minutes.

On test at 11,236-75 ft., oil surfaced in 1 hour and 8 minutes, and flowed 36 bbl. in 45 minutes through ½-in. choke. Flowing pressure was 400 psi. On 2-hour gage through ¼-in. choke it made 55 bbl. of oil, under pressure of 900 psi. Bottom-hole shut-in pressure was 4,700 psi, in 30 minutes, gravity was 45.6°, and gas-oil ratio was 217:1. Drilling continued below 11,299 ft., in shale and lime having additional oil shows.

Stanolind owns full interest in the well, plus 1,600 acres in the vicinity. Location is in Section 209, Block G, ETRR Survey, 6 miles southwest of Seagraves.

Winkler County . . . Standard Oil Co. of Texas 1 Baird-Lovett, multipay discovery on the eastern flank of Kermit

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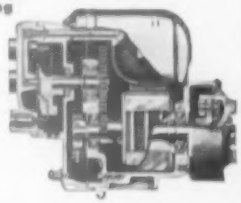

This is type FM-XOR six cylinder magneto with ball bearings throughout—available in base or flange mounting.

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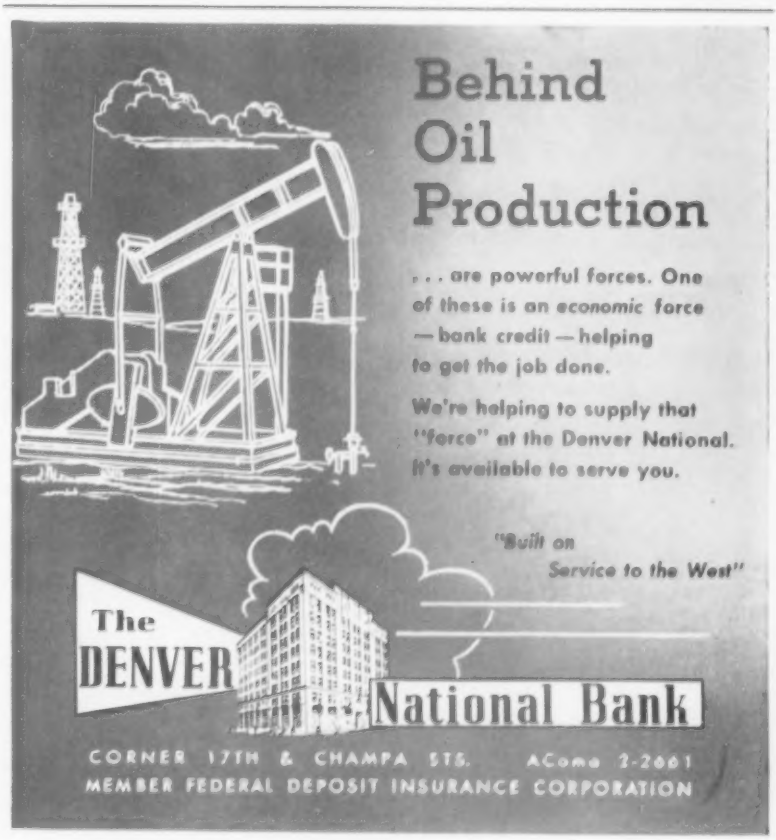
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*Personal note to WILLIAM HOLDEN

star of Columbia's new movie, "Picnic" (who, as Hal Carter, says he's coming to Tulsa to work "in the Mayo"): come on down, Bill—we'd love to have you! But remember . . . learning the hotel business is no "picnic." We really work at it . . . ask any of our guests!

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field, northwest of the town of Kermit, reported a flow from the Ellenburger.

Flowing through 16/64-in. choke, the well tanked 168 bbl. of oil in 24 hours. Pay was between 10,622-28 ft. Flowing tubing pressure was 675 psi. This well also indicated several pays higher in the hole.

Andrews new pay . . . Skelly Oil Co. has completed its 7-F University as a dual Ellenburger and Mississippian well on the eastern flank of Emma-Ellenburger field. The Mississippian is a new pay for the area.

Potential from the Mississippian was 882 bbl. of 45.8° oil a day through 1-in. choke, from perforations at 10,170-10,200 ft. Casing pressure was 175 psi.

Ellenburger potential was 2,616 bbl. of 49.8° oil a day through 1-in. choke on tubing, from perforations at 12,330-12-468 ft. Gas-oil ratio was 618:1.

GREAT LAKES

MICHIGAN

First Dundee objective test well for the Huber Traverse oil pool, Denver Township, Newaygo County, was announced this week by Klondike Petroleum Co., Inc., discovery company in the pool.

Klondike will deepen a well on the north-northwest side of the pool from its present point in the Traverse, where hole filled 1,800 ft. with oil in 24 hours but failed to flow, the additional 400 ft., more or less, to test lower horizons.

The Traverse oil pay at this deeper objective test well, the 3 Millis, NE NW SE 5-14n-14w, was squeeze-cemented off in preparation for drilling to the lower objective with cable tools. A long string of 7-in. casing was set above Traverse pay at 2,112 ft.

Top of Traverse lime at 3 Millis was logged at 2,114 ft. Pay showed in top 6 ft. of Traverse section drilled. Well was structurally higher than a producing well to the northeast by 9 ft., 3 ft. higher than a flowing well at the 2 Millis, the east offset, and 2 ft. lower than 1 Millis flowing well.

A semi-outpost, located nearly a mile further to the northwest was announced at this same time by Klondike. This new outpost well, which will be drilled to test Traverse, is at the 1 Schwing, SW NE NW 5-14n-14w.

● Successful oil well number six for the Lincoln "6" Dundee oil pool, Lincoln Township, Clare County, was being flowed natural at 6 bbl. of oil an hour this week at the William B. Stewart and Basin Oil Co. 3 State-Lincoln, NE NE SW 6-18n-5w. Top of Dundee was logged at 3,954 ft. Pay showed at 3,962 ft. and total depth, 3,964 ft. Well flowed 200 bbl. of oil in 3 hours through 5-in. casing before tubing was run.

HUGOTON EMBAYMENT

TEXAS PANHANDLE

Prairie Field Confirmation Well Is Morrow Producer

The confirmation well to Morrow-Prairie field in Hansford County, 4½ miles south of Hansford, Tex., is completed. Sun Oil Co. 1 Coy Holt, Sec-

These Shares have not been and are not being offered to the public. This announcement appears as a matter of record only.

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tion 145, Block 45, H&TC Survey, was finaled last week flowing 26,000 M.c.f. of gas per day and 1 bbl. of distillate per million from perforations in the Morrow sand at 7,021-42 and 7,035-42 ft.

MID-CONTINENT

OKLAHOMA

State Activity Is Tops Among Nation's Provinces

Exploration in Oklahoma is at its highest and most successful peak in several years. The state is one of the busiest areas in the nation, both in new wildcat work and in field development. Every section of the state reports discoveries of high caliber and significance.

South-Central . . . British-American Oil Producing Co. recently completed one of the outstanding discoveries in this portion of the state in many years.

The 2 Harrison in the Knox area (29-3n-5w, Grady County) opened the state's deepest production at 15,300 ft. in the Ordovician sands. The excellent deep strike flowed 175,000 M.c.f. of gas per day and 26,000 bbl. of distillate per day. The well produced from open hole at 15,250-15,310 ft. The discovery further accelerates the intense interest in the deep potentialities of the Ordovician sands of this section of Oklahoma.

. . . Carter County. Frankfort Oil Co. established a new pay in the Lone Grove area at its 1-A Greenwood, NW SW NW 12-5s-2w. The discovery flowed 240 bbl. of new oil in 16 hours from perforations in the Greenwood sand at 5,327-52 ft.

. . . Grady County. The North Bradley area (northeast part of 5n-5w) is undergoing a rapid expansion program. Gulf Oil Corp. has gotten flow potentials of more than 1,000 bbl. of oil per day in the Bromide sand reservoir.

. . . Love County. Frankfort's 1 Gardner, SW NE NW 35-6s-2e, is nearing completion as a deep Arbuckle lime discovery. Tests flowed 8 bbl. of oil hourly from the 11,921-ft. mark.

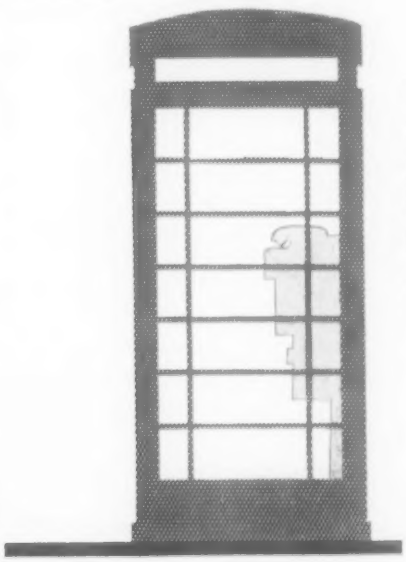
. . . Murray County. Frankfort dually completed the 1 Hale in SW NE 4-1s-1e. Production is from Arbuckle through perforations at 7,045-7,110 ft. and 6,885-6,934 ft. The well flowed 325 bbl. of oil per day on small choke from these two zones. Location of the strike is west of Davis on the north side of the Arbuckle Mountains.

. . . Stephens County. Blackwell Oil & Gas Co. 2 Sledge in NE SE SE 33-1s-5w is an important extension and pay discovery in the West Velma area. The well flowed 104 bbl. of oil per day from the Markham sand at 6,448 ft.; from the Aldridge sand the well flowed 75 bbl. daily at 6,943 ft.

Southeast . . . One of the best strikes in recent years for the McAlester-Arkansas Valley basin province in southeastern Oklahoma flowed on calculated open flow 42,600 M.c.f. of gas per day from perforations at 4,826-72 ft. The well is Southern Union Gathering Co. 1 Follansbee, SW NW SW 18-9n-15e, McIntosh County.

At the other end of the long basin in Arkansas Carter Oil Co. opened a new gas field in Conway County near the town of Jerusalem. Production is from the Atoka-Penn. These two discoveries should spark new interest in the waning province. There has been considerable seismic and leasing work in McIntosh, Sequoyah, and Muskogee counties in recent weeks, promising a definite pickup in exploratory work this year.

Northern . . . The 30-mile trend of basal Pennsylvanian production in Grant and Alfalfa counties continues to grow. The latest extension discovery of importance is Woods Petroleum



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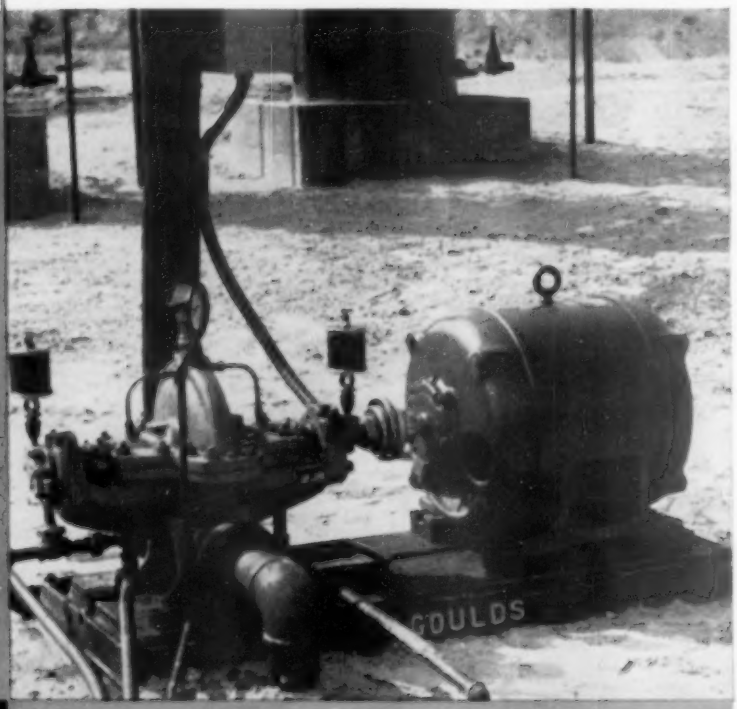

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Co.'s 1 Tucker in SE SE 13-28n-10w, 2 miles west of Flowerdale field production. The well flowed 159 bbl. of oil per day from 4,922-38 ft. in the basal Penn sands.

. . . Woods County. Activity in northwestern counties is picking up, particularly in Woods County.

Oil Trading Co. and Brooks Hall 1 Thurman, SE SW 20-29n-13w, pumped 32 bbl. of oil in 24 hours to open a new field near the Kansas line. Production is from the Mississippian chat.

Amerada Petroleum Corp. moved Bartlesville sand production to its westernmost point in Oklahoma at 1 Morgan, NE SE 20-24n-13w. The well is in the Oakdale area, a recent Simpson sand discovery. The 1 Morgan flowed 4,378 M.c.f. of gas per day from 6,102-22 ft.

. . . Harper County. The Buffalo area of northwestern Oklahoma is the center of keen exploratory interest as a result of Magnolia Petroleum Co.'s 1 Stinson discovery in NE SW 12-26n-25w.

The well is a prospective producer from three Pennsylvanian sands, the Hoover, Tonkawa, and Morrow. Several deep wildcats are planned for this county in coming months, particularly in the 30-26n-24w area.

. . . Central. Short Junction field, formerly known as West Short Junction, in Cleveland County, now has 100 producing oil wells. The pay zone (Hunton lime) is near 8,000 ft. Most of the wells flow nearly 500 bbl. per day on potential. The northeast and northwest sides of the field have been successfully extended in recent weeks, promising further activity for the remainder of the year.

NORTH TEXAS

Taylor County Strike Flows 252 BOPD

H. M. Gogle 1 Heatley has opened flush pay from the Gray sand in West Lawn, (Gardner sand) field in southeastern Taylor County.

Potential was 252 bbl. of 42° oil through 16/64-in. choke, from pay at 4,101-07 ft. Flowing tubing pressure was 200 psi., with gas-oil ratio of 784:1. Location is in the Josus Yarbo Survey 464.

Knox County . . . The Noba Strawn field 3 miles west of Knox City has gained its second producer at Thomas D. Humphrey & Sons 2 Noba Oliver. Potential was 150 bbl. of 39° oil a day through 16/64-in. choke. Pay section was open hole at 4,860-73 ft. Flowing pressure was 220 psi. and gas-oil ratio was 295:1.

While drilling, 2 Oliver indicated production from the Strawn. Drill-stem test at 4,853-73 ft. had oil at the surface in 1 hour and 40 minutes, but was not allowed to flow.

S.E.G. OFFICES

Nominations Announced For S.E.G. Offices

Eight of the nation's outstanding geophysicists have been nominated for office in the Society of Exploration Geophysicists. For president Roy F. Bennett, chief geophysicist for Sohio Petroleum Co., Oklahoma City, will oppose Karl Dyk, chief geophysicist of Stanolind Oil & Gas Co., Tulsa.

E. V. McColium, of E. V. McColium & Co., Tulsa, and J. P. Woods, director of the Atlantic Refining Co., geophysical laboratory in Dallas, have been nominated for vice president.

For secretary-treasurer T. O. Hall, president of General Geophysical Co., Houston, will be opposed by John C. Hollister, head of the department of geophysical engineering at Colorado School of Mines, Golden.

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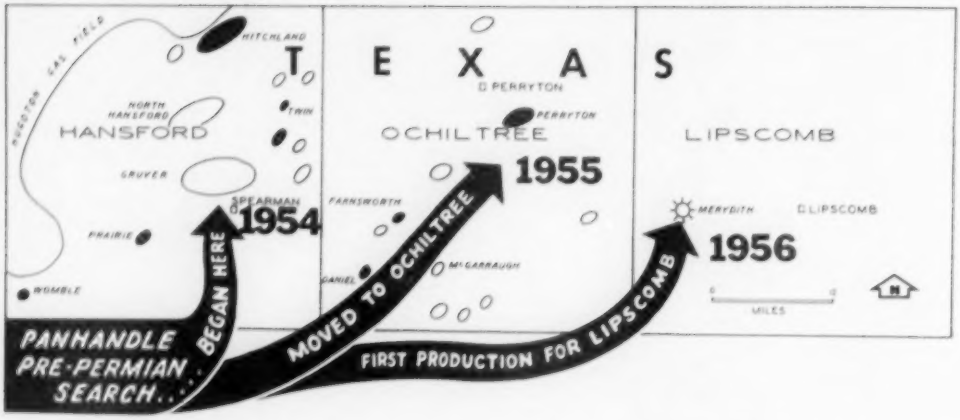


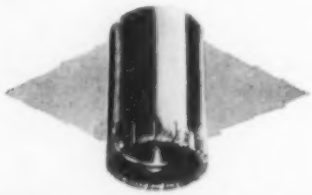
Hansford, to Ochiltree, to Lipscomb in 2 years. That's . . .

Pre-Permian Exploration on the March

by John C. McCaslin

PRE-PERMIAN exploration in the Texas Panhandle in the past 2 years has marched right across the northern tier of counties east of Hugoton field from Hansford to Ochiltree and now Lipscomb. The Pennsylvanian push began back in 1954 in Hansford County, spread in all directions in that county during the following months; last year the exploratory program moved into Ochiltree County with gusto and success; early in March, Humble Oil & Refining Co. opened first production in Lipscomb County in the far northeastern corner of the huge Panhandle region, raising hopes for another "Hansford or Ochiltree" in the Lipscomb County area.

THE OIL AND GAS JOURNAL



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The play begins . . . The pre-Permian play in the Hugoton embayment of the western Anadarko basin is now well established. It began early in 1954, spread out later that year and in 1955, and now embraces a vast region of the Texas and Oklahoma panhandles and Southwest Kansas. Each of the three state regions has its own exploratory and development story. The Texas Panhandle story is divided into three parts.

. . . Hansford. In 1954 this Texas Panhandle County was the busiest place in the entire Hugoton region. North Spearman-Morrow gas field was the opening-gun discovery. From there the play moved into the East Gruver Gas Unit area, 10 miles west. Later oil production was found in the northern part of the county, opening Hitchland field. New pay sands in the Pennsylvanian popped up in every corner of the county . . . the Douglas, Atoka, Virgil, Tonkawa, Lovell, Strawn, Oswego, Cherokee, and Marmaton. The two most important pays in Hansford County are still the Douglas and Morrow, however. The most important fields in this area are: Gruver, North Hansford, Hitchland, and Twin-Morrow.

Lack of Outlet

The Hansford County development work slowed down considerably in 1955 due to lack of outlet. Operators now expect development of North Hansford gas field to pick up with the prospects of a long-awaited pipeline outlet. Northern Natural Gas Co. plans to build a gathering system and short connecting pipeline from the field to the company's main line. Northern recently completed contracts covering purchase of gas from 16 Hansford County wells. There are 40 gas wells in North Hansford field.

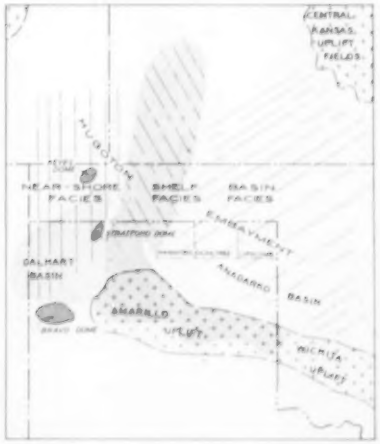
Construction on the gathering system, pipeline, and a centrally located dehydrating plant will begin this spring. First gas will move out this summer.

. . . Ochiltree. Last year Texas Panhandle exploratory interest shifted from Hansford into Ochiltree County to the east.

One of the best discoveries in this county was Woodson Oil Co. 1-A Perry Unit, a Seven Fingers lime and Morrow sand discovery. The dual strike flowed 4,000 M.c.f. of gas per day and 330 bbl. of oil from the two pays. The discovery opened Perryton field. Another important area is new Farnsworth field. Morrow oil and gas production is found in this area. There were 11 wildcats and 3 field wells drilling in Ochiltree as of March 1, ranking it third in Texas Panhandle County activity.

. . . Lipscomb. The newcomer to Texas Panhandle exploratory circles is Lipscomb County in the far northeastern corner of the region.

Humble Oil & Refining Co. opened first production in this little-explored county in February at the 1 W. C. Merydith, 14 miles west of the town of Lipscomb. The discovery well flowed 1,100 M.c.f. of gas daily plus 29 bbl. of condensate. The flow was on ¼-in.



Pennsylvanian rocks in the Hugoton region fall into three provinces . . . basin, embayment, and near-shore to continental.

ANOTHER PIPELINE GATHERING PUMP

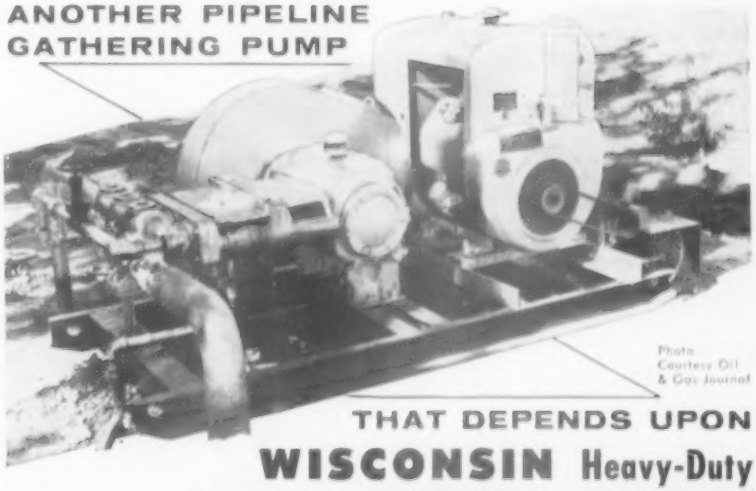


Photo Courtesy Oil & Gas Journal

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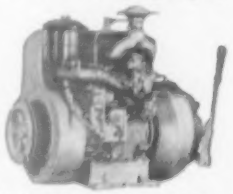

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choke, through perforations in the Lower Pennsylvanian at 10,162-10,205 ft. Nearest production is about 10 miles southwest in Ochiltree County. One other wildcat is drilling in the northeastern part of the county. Humble's success should spark considerable interest in the potentialities of this portion of the Texas Panhandle.

Panhandle Notes

The Texas Panhandle portion of the Hugoton embayment of the Anadarko basin is bordered on the west by the Stratford dome and on the south by the Amarillo uplift. The beginning of present day activity in the region was back in 1949 with the 1 Lips discovery by Sinclair Oil & Gas Co. That well was plugged and abandoned after 1 year. Oil congealed at 80°, making production difficult. Gulf Oil Corp. 1 Harbough found Morrow gas production in Ochiltree County. This well was also abandoned later, but it did stimulate new interest in the region.

The pre-Pennsylvanian is relatively unexplored. Most wells stop below the top of the Mississippian. There is one Ellenburger well producing in the Texas Panhandle, and there is some Mississippian production in Hansford County. The Siluro-Devonian is only about 1,000 ft. thick . . . is tight and shaly. Some Simpson sands have been found, but are disappointing. There are at least a dozen Pennsylvanian sands in the Panhandle. The upper Morrow at 7,000 ft. is the best found to date. Some people think it is Atoka, but it is easily correlated with the Morrow sand of the Oklahoma Panhandle and Southwest Kansas. The Morrow sand is erratic, not blanket. Its origin is believed to be offshore bars. It is an attractive, but unpredictable prospect.

The Tonkawa-Pennsylvanian, either lower Virgil or upper Missouri, has produced some excellent gas wells. This is also an erratic sand.

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GULF COAST

TEXAS GULF COAST

Gasser Reveals New Area Near Galveston Bay Field

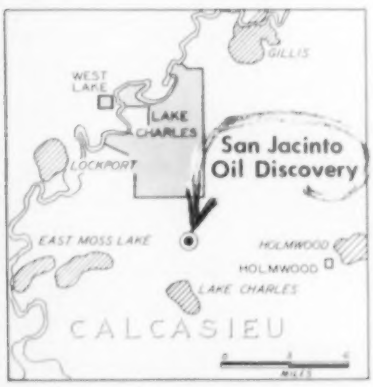
Humble Oil & Refining Co.'s new discovery well in the Red Fish Reef area in Galveston Bay, off Smith Point, Chambers County, is rated good for 78,000,000 cu. ft. of gas daily, openflow. Gas carries 59.7°-gravity condensate in the ratio of 13,143 cu. ft. per barrel. Production is from perforations at 11,246-60 ft.

Location is more than 1 mile east of production in Red Fish Reef field and 1½ miles southwest of Smith Point field, also in Galveston Bay. It also is about 2 miles west of The Texas Co.'s East Smith Point field, adjacent to Smith Point.

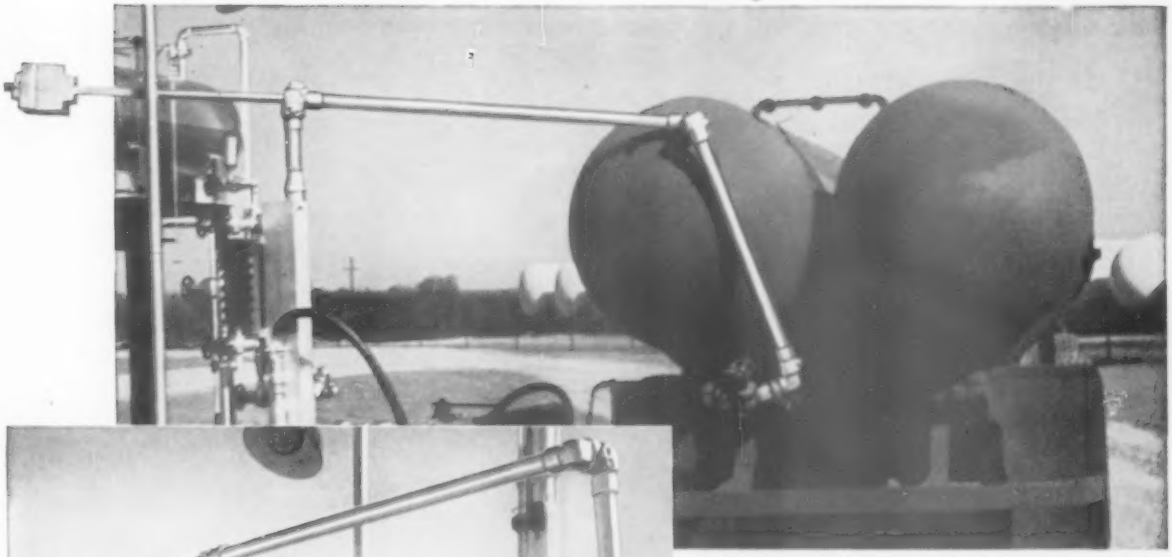
SOUTH LOUISIANA

Calcasieu Parish Wildcat Indicates New Oil Field

Discovery of another oil-productive area in Calcasieu Parish virtually is



Location of San Jacinto Petroleum Corp.'s new oil-discovery south of Lake Charles, in Calcasieu Parish.



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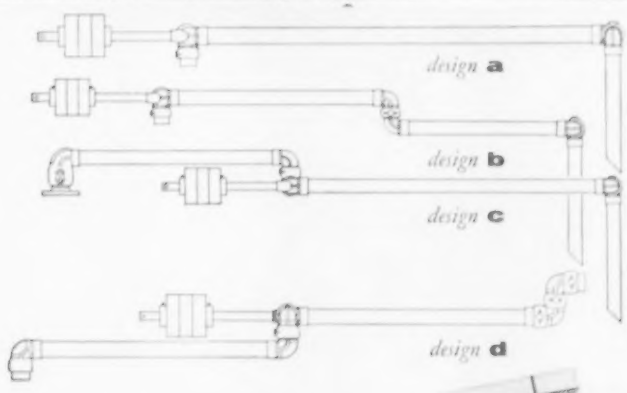
Any required degree of flexibility is provided, simply by arranging CHIKSAN ball-bearing swivel joints in proper sequence. Total length of any arm is governed by the required length of pipe sections between swivels. Whether it be a standard design loading arm or a special design for a specific problem, write CHIKSAN today, the nature of your requirements.

Write to Dept. 33 for Catalog giving complete detailed information.



The four loading arms illustrated are standard CHIKSAN designs and can be ordered as a package. These loading arms are also available for the handling of chemicals and steam.

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assured by results of initial testing in a wildcat drilled by San Jacinto Petroleum Corp., of Houston, 4 miles south of Lake Charles.

The indicated discovery well is the company's 1 Cormier-LeBleu Unit, in 33-10s-8w. It was drilled to 9,768 ft., and has casing run to 9,755 ft. Initial perforations are in an upper Frio sand at 8,922-38 ft. Testing through ⅛-in. choke, it flowed at the rate of 150 bbl. of 41.5°-gravity oil per day. Flow was under pressure of 1,300 psi. with gas-oil ratio of 900 cu. ft. per barrel.

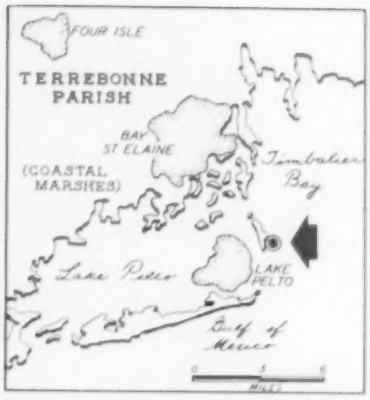
Additional perforations, taking in more sand, are being made before running production packer and completing.

Location is about 2 miles north of Lake Charles field, and about 3½ miles northeast of East Moss Lake field.

Deep Discovery Extends Production at Lake Pelto

Sun Oil Co. is opening a new ultra-deep productive reservoir associated with the Lake Pelto dome, in the coastal marsh area of Terrebonne Parish, at an outpost location off the east flank of the dome and about 2 miles east and a little north of nearest production.

The reservoir, in Miocene sand, perforated at 15,526-36 ft., is productive in the company's 1 State Lease 2620, drilled to total depth of 12,021 ft.



Lake Pelto area in coastal marshes of Terrebonne Parish showing Sun Oil Co.'s deep discovery-well off the east flank of the dome. "A" is location of Union Oil Co.'s deep test off the opposite side of the dome.

Tested through 9/64-in. choke, the well flowed at the rate of 300 bbl. of 31.7°-gravity oil per day with pressure of 3,900 psi. and gas-oil ratio of 1,666 cu. ft. per barrel. No water was indicated.

Interest now is directed to deep wildcat which Union Oil Co. is drilling about 3 miles southwest of production off the opposite (southwest) flank of the dome. It is on Union's State Lease 2649. It is projected to 15,500 ft., and at latest report was drilling below 13,500 ft.

West Maxie Area Wildcat Opens New Gas Production

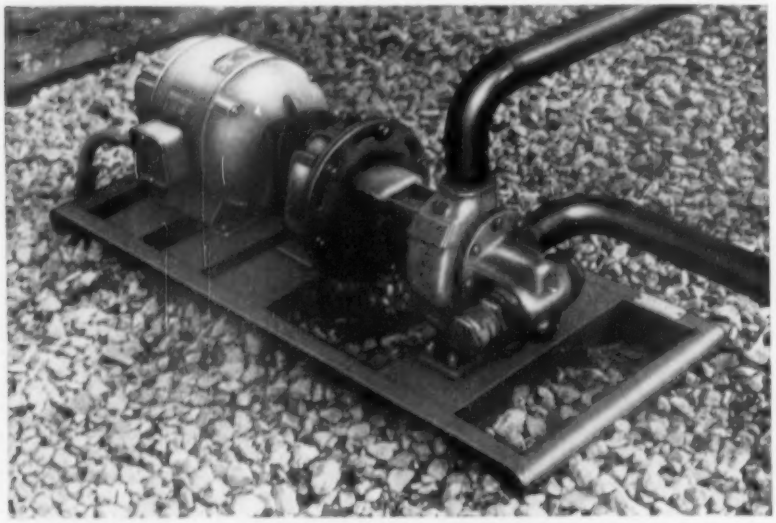
Austral Oil Exploration Co., Inc., of Houston, has a new gas-condensate discovery 1 mile northwest of the West Maxie area, in Acadia Parish.

Its discovery well, 1 Grant D. Hayes, in 36-8s-1w, is rated good for 6,000,000 cu. ft. of gas daily, flowing through ½-in. choke. Pressure was 6,500 psi., flowing, and 8,000 psi., shut-in. Liquid (high-gravity condensate) recovery was estimated at 20 bbl. per day.

Production is from Frio sand, perforated at 11,141-50 ft. Total depth is 11,250 ft.

West Maxie has two gas-condensate producers. It was discovered in January 1954 by Hassie Hunt Trust with production from perforations at 11,257-67 ft. Humble Oil & Refining Co. confirmed the discovery the following December at a location southwest of Hunt's producer. Humble, since then, has drilled a dry hole 4,200 ft. northeast of the discovery.

It has not been determined whether Austral's well opens a new field, or reservoir, or extends West Maxie's production at an up-structure location.



R & M 5 HP "All-Weather" Motor drives pipeline gathering pump

R & M "All-Weather" motors are famous throughout oil country for their tough, weather-resistant design. You defy the elements with R & M motors, because they are designed to resist tough weather conditions.

Completely Weatherized

Steel parts are specially treated to resist rust and corrosion. Rotor assembly is sprayed with rust inhibitor. Cast-iron parts are given a zinc chromate and iron oxide primer. Terminal box is gasketed. Leads are sealed at the shell with a non-hardening compound.

Dust and Rat-Proofed

The housing is designed to keep out rain, mud, and dust. Openings are factory-screened to keep out rodents and debris. There are no kits to buy and install. Yet you still get the extra guaranteed service factor of a 40-degree motor. Clean-sweep ventilation provides a straight, unobstructed path for cooling air. Extra-large ball bearings are pre-lubricated and sealed to keep grease in, keep dirt out.

Sold at Standard Motor Price

R & M "Oil Country" motors are available in triple-rated, high-slip, and high-torque designs. Yet with all these features, R & M motors are sold at a standard motor price. No wonder they are so serviceable on thousands of applications. And you'll find them outperforming most other motors on the tough jobs.

Get Complete Information

Available in single-phase, 1-15 HP; totally enclosed, 1-40 HP; open-protected polyphase, 1-200 HP. Write Dept. OG for bulletin on R & M Oil Country motors and name of nearest R & M representative.

R&M *"All-Weather" Oil Country* **MOTORS**

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"All-Weather" is an R & M trademark

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Here are features which make these single reduction Spiral-Bevel Units outstanding:

- High Efficiency . . . 97, 98% with small heat loss.
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These widely used Cooling Tower Drives are made in 5 sizes, rated from 15 h.p. to 75 h.p. at 1750 r.p.m. motor speed, with Ratios ranging from 3½ to 9½:1.

Be sure your next Cooling Tower is equipped with this dependable Philadelphia Drive. Literature upon request.

Write for Catalog CT-53, which illustrates and fully describes all types of Philadelphia Cooling Tower Drives and their applications: Spiral Bevel, Helical-Spiral Bevel and Worm Gear.

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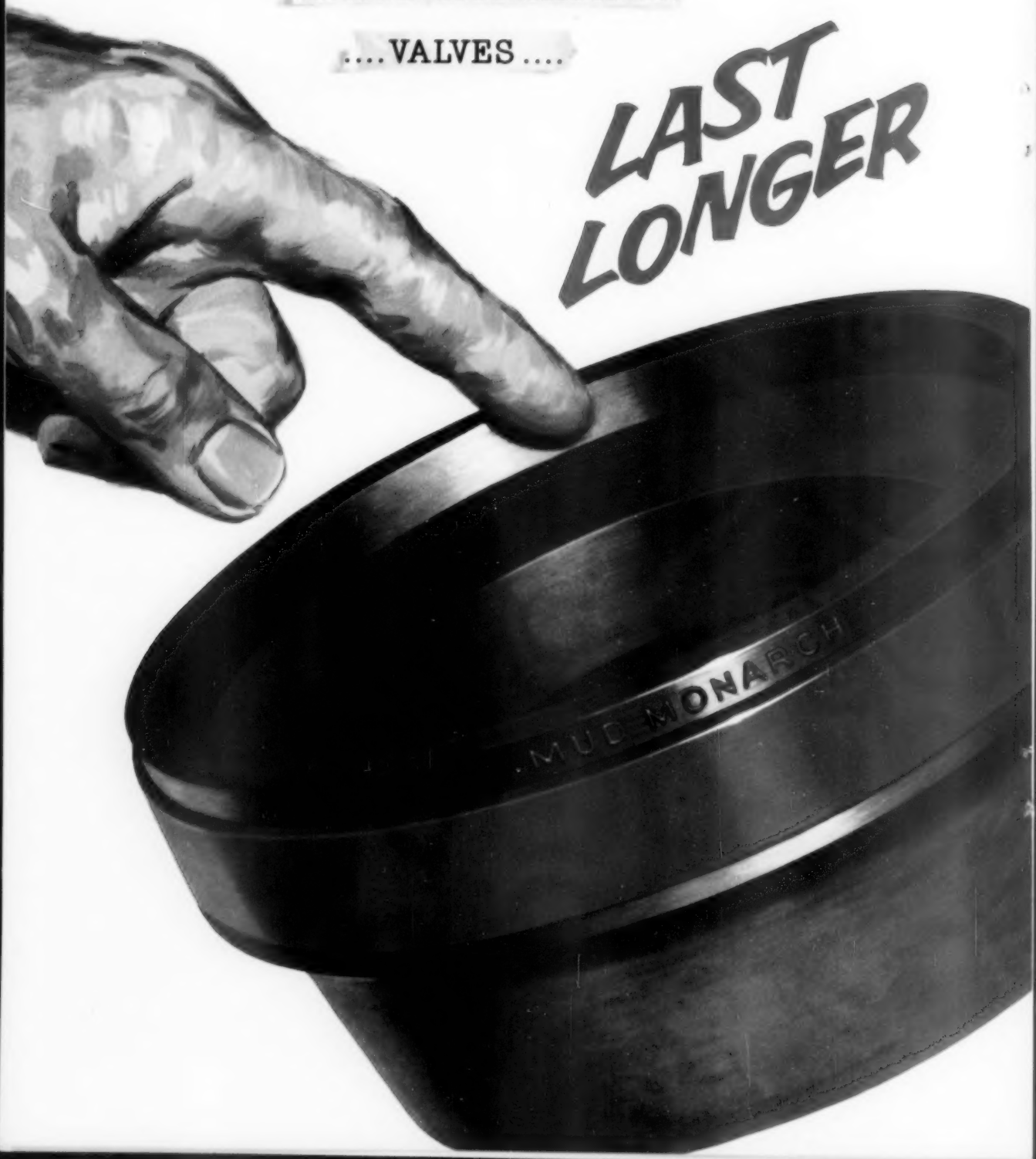
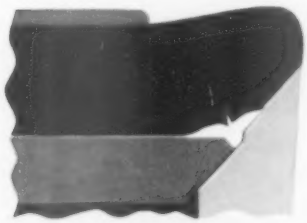
LAST LONGER



CONVENTIONAL

Conventional valves use a sealing element that seals at an angle, usually in the same plane with at least part of the striking surface. This arrangement works well **when the valve is new and when pump pressures are low.**



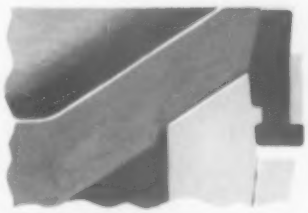
With wear, however, an opening forms at the junction of valve body, seat and sealing element. High pump pressures force part of the rubber sealing element into this space and it is pinched off. The result is short life for both sealing element and valve.

MISSION MUD MONARCH

NEW

With Mud Monarch Valves, the valve body strikes against the entire inclined surface of the valve seat, and the near-vertical seal ring seals against the outside diameter of the valve body. With this design, seal ring life is independent of valve and seat wear.

OLD



With wear, the entire inclined striking surface of the seat is worn away. An opening can't form next to the seal ring. Both valve and seat wear longer before they need be replaced and seal ring life is increased substantially—

HERE'S WHY MUD MONARCH VALVES LAST LONGER THAN CONVENTIONAL VALVES UNDER JET DRILLING CONDITIONS

Most slush pump valves do a good job when they are new, but when valve body and seat become worn, an opening forms between seat and body next to the sealing element that plays havoc with valve life. This condition exists, to a certain degree, with all valves except the Mud Monarch. By preventing the formation of this opening, Mission Engineers have developed a valve that gives truly outstanding service – especially in high pressure jet drilling where most valves fail rapidly. If you are dissatisfied with the service you are getting from slush pump valves, try the Mission Mud Monarch. You will discover a new high in valve performance and a new low in valve costs. Like all Mission Products, Mud Monarch valves are guaranteed to give outstanding service or your money is refunded. You can't lose, so try them right away. They are made in sizes to fit most pumps and are available through all supply stores.

Mission Mud Monarch Valve

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Pipeline construction. Moving out ahead of roads, to places other vehicles can't go, the "go-anywhere" performance-proved 4-Wheel-Drive 'Jeep' Truck carries men, tools and equipment along the right-of-way to speed the laying of pipelines.

'Jeep' vehicles GO where others can't to speed Oil and Gas operations!

Exploration. In good weather or bad, the Universal 'Jeep', with the extra traction of its 4-wheel drive, takes geologists, seismograph crews, tools and equipment to the most remote areas—wherever they need to go—regardless of rough or rocky terrain.

Transportation. Whether carrying engineers for inspection trips on the lease, or transporting supervisors and work crews, the 4-Wheel-Drive 'Jeep' Station Wagon is always on the move. Carries up to 110 cubic feet of equipment or six passengers.

Today, in nearly every phase of the oil and gas industry, whether transporting men and equipment cross-country, or operating a mobile drill for shot holes, 4-Wheel-Drive 'Jeep' vehicles are on the job, keeping work moving smoothly and on schedule.

These vehicles were designed for just such tough assignments as exploration for and transmission of oil and gas. No other vehicles can match their combination of stamina, versatility and the extra traction of 4-wheel drive. Time-tested and performance-proved, they've demonstrated their ruggedness in job-after-job. With the extra traction of "go-anywhere" 4-wheel drive they patrol along the pipeline or prospect—through mud, sand, soft earth or up steep inclines. They haul heavily loaded trailers over muddy lease roads, in good weather or bad. On the highway, they travel in conventional 2-wheel drive at top legal speeds.

"Go-anywhere" 'Jeep' vehicles spread their costs over an almost endless number of jobs, give you additional savings through long life and low maintenance costs. Ask your Willys dealer for a practical, on-the-job demonstration, or write for information and detailed specifications to Dept. W, Willys Motors, Inc., Toledo 1, Ohio.

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WILLYS MOTORS, INC., TOLEDO 1, OHIO

New manager for Canadian firm . . .

. . . Magnolia's Moore Promoted

THE young-looking gentleman in the photograph receiving congratulations on his promotion is getting a running start on his new job.

Fred H. Moore, assistant to the president of Magnolia Petroleum Co., Dallas, arrived in Calgary last week to acquaint himself with operations of Mobil Oil of Canada, Ltd.

On April 1, Moore will become executive vice president and manager of the live-wire outfit which, like Magnolia, is an affiliate of Socony Mobil Oil Co., Inc.

Both the 47-year-old executive and the company he is joining are on the way up. The past 3 years have seen Mobil Oil of Canada boost crude-oil production from about 1,200 to more than 20,000 bbl. daily. The payroll has grown from 230 to almost 900. The company holds exploration rights on about 8,500,000 acres in Western Canada.

Moore comes to his new assignment with a wide knowledge of the oil business gained in jobs ranging all the way from finding crude oil to buying and selling it. He has spent 21 of his 47 years with Magnolia, the last 6 as an executive.

Geological start . . . Moore decided early in high school that he wanted to be a geologist.

He was attracted to the oil business by the Ranger-Hogtown (Desdemona) oil boom near his home in Comanche, Tex. Another influencing factor was Moore's boyhood acquaintance with two widely known geologists from Comanche, Robert T. Hill and Gayle Scott.

He earned a bachelor's degree in geology from Texas Technological College in 1930 and a masters from the University of Virginia in 1931. He went east for the latter degree primarily to learn more about structural geology by close association with the Appalachian Mountains. Two years of advanced geological study followed in the graduate school of Yale University.

Earning his own way in school, Moore spent the summers of 1931-33 mapping the Marble Belt of western Connecticut for the Connecticut Geological Survey.

With the depression in full swing, he had to defer starting his oil career in favor of a job digging ore for U. S. Gypsum Co. at Oakfield, N. Y. He emerged, as he put it, 1½ years later to go to work for Magnolia as a field geologist in Oklahoma.

The next 16 years took him up through the geological department, including a stint at Roswell, N. M., where he organized a new geological division in the late 1940's before becoming a staff geologist in the Dallas headquarters.

The turning point . . . Management soon began to groom the bright young geologist for bigger things.

The beginning of a new phase to his career was his selection to attend the Harvard University advanced management course in 1951. He was named assistant to the president that year. The next year Magnolia also made him manager of crude-oil purchases and sales. This experience greatly broadened his knowledge of the industry.

Possessing the rockhound's love of the outdoors, Moore likes to spend his leisure time hunting quail. He has had to turn to gun collecting in recent years as it is less time-consuming. He now owns 25 single-action weapons, which is all that Mrs. Moore will permit around the house.

Moore's wife and two teen-age daughters, Carla and Mary, will join him in Calgary in June after the spring school term closes.

Moore is active in industry association work. He is a fellow of the Geological Society of America and a member of the American Association of Petroleum Geologists and of the American Geophysical Union. He is a director of Texas Technological College and of the Texas Mid-Continent Oil and Gas Association.

Seth J. Abbot, Jr., former production engineer for Atlantic Refining Co., has joined Tekoil Corp. as petroleum engineer in Dallas. He will supervise Tekoil's West Texas water-flood activities. Before joining Atlantic, Abbot was with the U. S. Bureau of Mines in Dallas.

Pete W. Cawthon, Jr., has been promoted from assistant cashier and petroleum engineer to vice president in the oil and gas division of Houston's City National Bank.

H. P. TAUBMAN

Herman P. Taubman, founder and president of Buffalo Oil Co., has been named board chairman of the Tulsa firm. He is succeeded by his son, **Morris B. Taubman,** Fort Worth, former executive vice president. **W. W. Lomerson,** former assistant to the vice president, becomes vice president. The

M. B. TAUBMAN

W. W. LOMERSON

younger Taubman and Lomerson will remain in the firm's southern regional offices in Fort Worth.

Personals

W. G. Orr has been promoted by Texas-U. S. Chemical Co., Port Neches, Tex., from technical superintendent to technical assistant to the general manager.

Carl Kearfott has been named drilling and production superintendent for Freeport Oil Co., New Orleans. Other appointments in the Freeport Sulfur Co. subsidiary: **J. M. C. Gaffron,** to assistant to the vice president; **Paul Noll,** assistant to Kearfott; **R. M. Jemison, Jr.,** district geologist; and **G. B. McBride,** West Texas-New Mexico superintendent of land and exploration, Midland, Tex.

G. E. (Skip) Stahl, with Northern Natural Gas Co. 5 years, has been named to the newly created post of manager of gas purchases. He also will head gas purchases for Permian Basin Pipe Line Co., a Northern subsidiary.

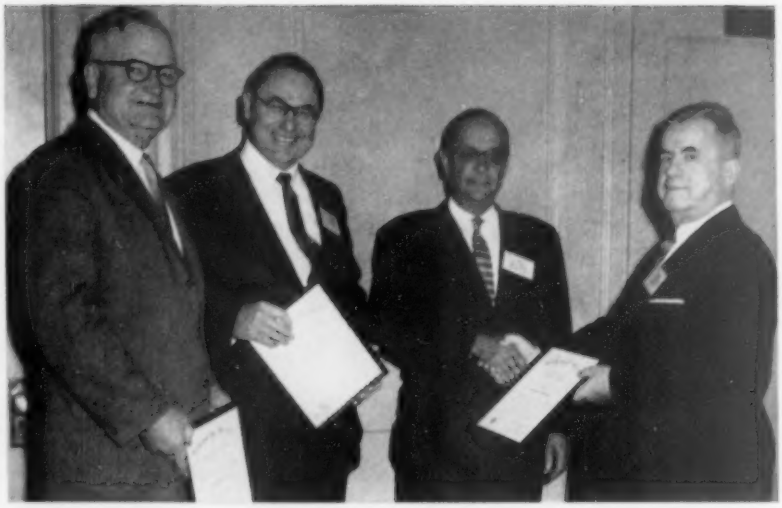
C. R. Richards has been promoted by Sinclair Oil & Gas Co. from production foreman in Nowata, Okla., to district superintendent in Carmi, Ill. He replaces **J. W. Stoker,** transferred to Seminole, Okla.

R. James Gear has resigned as zone secondary recovery engineer for Gulf Oil Corp. in Wichita, to become production engineer for Mull Drilling Co. there, effective April 1.

S. R. Cross has been advanced by Continental Oil Co. from division geologist in Wichita to assistant regional geologist in the central region, Oklahoma City. He succeeds **P. R. Warren,** recently named regional geologist.

Lewis M. Thompson has been promoted by Cosden Petroleum Co. from drilling and production engineer to production manager in the firm's Big Spring, Tex., headquarters. Before joining Cosden in 1953, Thompson headed Stanolind Oil & Gas Co.'s Lubbock, Tex., division drilling department.

Texas Railroad Commissioner Olin Culbertson has been chosen to receive the Texas Independent Producers and Royalty Owners Association's 1956 "recognition award." Culbertson will be honored for "his contributions to the entire industry and for his role in preserving conditions vital to the continued survival and prosperity of independent producers and royalty owners." He'll get the award during T.I.P.R.O.'s tenth annual membership meeting April 15-17 in Dallas.



A.P.I. Southern District Production Men Honored

The American Petroleum Institute's Division of Production has honored three Houston men for their services in the A.P.I.'s southern division. Left to right, they are W. B. Duncan, Houston Oil Co. of Texas; George B. Kitchel, Kerr-McGee Oil Industries, Inc.; and George E. Cannon, Humble Oil & Refining Co. A. W. Thompson, A.P.I. production vice president, right, presented citations to the three at the division's recent district meeting in San Antonio.

C. A. Swigart, president of Trans-Arabian Pipe Line Co. since 1951, has been named board chairman and chief executive officer. **John Noble,** former associate counsel of Arabian American Oil Co., succeeds Swigart. **W. R. Chandler,** vice president of Tapline, becomes executive vice president.

Dr. Earl T. McBee, head of Purdue University's chemistry department, has been elected a director of Great Lakes Oil & Chemical Co.

W. S. Payne, Jr., has resigned as chief production engineer for Richfield Oil Corp. in Los Angeles to become a partner with **W. H. Stansbury,** California independent, in Long Beach. Payne joined Richfield in 1940 as a petroleum engineer.

Frank Neighbor, Salt Lake City, has been elected president of the Rocky Mountain section, American Association of Petroleum Geologists. Other new officers: **Dave Moore,** Casper, Wyo. vice president; and **Walter Quigly,** Salt Lake City, treasurer.

Paul Jennings, former head of Kansas operations for Geophysical Consultants, Inc., Tulsa, has been named geophysicist and geologist for Birmingham-Bartlett Drilling Co., Wichita.

W. E. Griffith, Jr., formerly with Atlantic Refining Co.'s production and drilling engineering sections, has joined Gibralter Oil Corp. as West Texas division engineer in Midland, Tex.

Frank A. Morgan, former vice president and exploration manager for Richfield Oil Corp., has opened Los Angeles engineering offices. With his son, **Frank A. Morgan, Jr.,** he'll specialize in exploration and development, both domestic and foreign.

William E. Cordell has been promoted by Stanolind Oil & Gas Co. from field superintendent in the Beeville, Tex., area to district superintendent in Corpus Christi. **P. Dix Laughter** moves up from production foreman to succeed Cordell.

Bob Walker, Gulf Refining Co., Evansville, Ind., has been elected 1956 general chairman of the Illinois basin section, American Institute of Mining, Metallurgical & Petroleum Engineers. Other new officers: **George Link,** Carter Oil Co., Olney, Ill., vice chairman; and **Fletcher Farrar,** Mount Vernon, Ill., independent, secretary-treasurer.

Richard H. (Doc) Cook, former gas supply manager for Houston Pipe Line Co., has joined Warren Petroleum Co.'s gas division as district representative.

William H. Curry, Rocky Mountain independent geologist and president-elect of Rocky Mountain Oil and Gas Association, has been elected a vice president of Associated Royalty Co., Denver.

R. G. Perry has joined D. D. Feldman Oil & Gas Co., Dallas, as Canadian exploration manager.

T. Wayne Hurt, former assistant exploration manager in Texas Pacific Coal & Oil Co.'s Canadian division, has been promoted to manager. He succeeds **Edd Riddle, Jr.** Other Texas Pacific changes: **Nolan Hirsch,** advanced from district geologist in Midland, Tex., to chief exploration and development geologist in Fort Worth, replacing **W. L. Gupton, Jr.,** resigned; **Robert L. Porter,** subsurface geologist in Abilene, becomes assistant to Hirsch; and **Cecil Aycock,** former assistant to Hirsch, becomes district geologist in Midland.

Frank Forsyth has resigned as production superintendent for Sinclair Oil & Gas Co. in Midland, Tex., to become drilling and production superintendent for Hanley Co. there. Forsyth replaces **H. D. Murray,** who resigned recently.

J. B. Oakley, Jr., senior petroleum engineer in Calgary for Stanolind Oil & Gas Co., has been promoted to assistant Canadian division engineer.

Malcom C. Lowe, Peter D. Burland, and **Charles L. McDaniel** have been named group leaders in Lion Oil Co.'s development department in Luling, La. Lowe and Burland will deal with project evaluation. McDaniel will head product development activities.

A. J. Seidule has been promoted from laboratory supervisor to assistant superintendent of Dow Chemical Co.'s Freeport, Tex., polyethylene plant. **I. R. Zelade,** formerly research and development engineer of the ethyl chloride plant in Freeport, has been named assistant superintendent.

James A. Jesse, with Cooperative Refinery Association since 1951, has been named Kansas district geologist. He succeeds Elliot Bratt, resigned.

W. B. Suard has joined Coral Drilling Co., Fort Worth, as drilling superintendent in New Orleans. Suard, who has 12 years' experience in offshore and Gulf Coast marsh drilling, will direct operations for this newly formed offshore contractor. **Harvey B. Elder,** drilling superintendent for Coral, has gone to Mobile to supervise construction of the firm's new offshore drilling platform.

Leonard B. Jones has resigned as pipeline engineer for Continental Oil Co. in Ponca City, Okla., to join Union Oil Co. of California as refinery engineer in Wilmington, Calif.

Richard F. Svoboda has resigned as geologist with Northern Natural Gas Co. in Omaha to join the Nebraska Geological Survey at the University of Nebraska, Lincoln.

John M. Payne, Shell Oil Co., has been elected 1956 chairman of the southern division of the American Petroleum Institute's Division of Production. New district vice chairmen: **J. F. Roth,** Shell Oil Co.; **W. E. Richards,** Rockhill Oil Co.; and **W. D. Taylor,** Schlumberger Well Surveying Co.

Gen. Anthony C. McAuliffe, U.S.A. (Ret.), has joined American Cyanimid Co. as head of a newly formed engineering and construction division. McAuliffe also will be president of Cyanamid's engineering subsidiary, Chemical Construction Co. In other changes, **George W. Russell** was named general manager and **Alden R. Loosli** his assistant in the industrial chemicals division.

Max S. Houston, head of El Dorado Refining Co.'s Denver exploration office for about a year, has been promoted to geological and exploration manager. He'll replace **Frank M. Brooks,** who is resigning effective May 1.

W. A. Bonawitz has been named senior chemical engineer in American Oil Co.'s research and development department, Texas City, Tex. He continues as group leader in the technical services section.

David Evans has resigned as chief geologist for Sharples Oil Corp., Denver, to become an independent there.

Personals

Paul M. McSpadden, former district superintendent at Winters, Tex., for Humble Oil & Refining Co., has been named superintendent of offshore drilling, a new operational division for Humble. **C. S. Yust** succeeded McSpadden.

Russell Farmer has resigned as geologist with U. S. Smelting Mining & Refining Co. to become chief geologist for Hill & Hill, Fort Worth. For several years Farmer was West Texas division geologist for Stanolind Oil & Gas Co.

C. G. Henderson, district production foreman for Pan American Production Co., has been transferred from the valley district at Lyford, Tex., to the central Louisiana district, Easton, La. **J. A. Short, Jr.,** moves up from senior production engineer to succeed Henderson in Lyford.

Karl E. Becker has resigned as district geologist for Petroleum, Inc., Wichita, to join Trans-Era Petroleum, Inc., there as chief geologist.

J. C. Preston, former executive secretary of Kentucky Oil and Gas Association, has resigned to become an independent in Owensboro. **R. A. (Bob) Reilly** succeeds Preston.

Williams to Head Mid-Continent A.I.M.E. in 1956

Guy Williams, Dowell Incorporated, Tulsa, has been elected 1956 chairman of the Mid-Continent section, American Institute of Mining, Metallurgical & Petroleum Engineers. The new officers are, seated left to right: John E. Eckel, Carter Oil Co. research laboratory, secretary-treasurer; Don R. Johnson, Gulf Oil Corp., first vice chairman; Williams; and Michael J. Rzasa, Cities Service Research & Development Co. Standing, left to right are the new directors: Robert C. Glover, Baker Oil Tools, Inc.; Connie L. Wilson, Sinclair Oil & Gas Co.; and Wayne Swearingen, with H. H. Kaveler, Tulsa. Not shown: Jack J. Reynolds, Continental Oil Co., Ponca City, and Shofner Smith, Phillips Petroleum Co., Bartlesville.

Personals

Jospeh B. Kennedy, vice president and Gulf Coast division manager for Sinclair Oil & Gas Co., has been elected a director. He will remain in Houston. Kennedy joined Sinclair in 1935 as geological scout in Shawnee, Okla. He was named vice president and division manager in 1954.

Donald D. Emrick, Wilfred B. Howsmon, and **James D. Idol,** all recently named doctors of chemistry by Purdue University, have joined the chemical and physical research division of Standard Oil Co. (Ohio). Emrick will work on mobile power oils and industrial products projects. Howsman is assigned to basic research, and Idol will deal with petrochemicals and microballoons projects in Sohio's research division.

Marshall E. Welbourn has been transferred by Shell Oil Co. from field exploitation engineer in Glendive, Mont., to division exploitation engineer in Billings, Mont.

W. O. Todd, retired drilling contractor and pioneer rotary driller, has been named honorary president of Petroleum Production Pioneers for 1956. **Hudson C. Drake,** of Belridge Oil Co., was chosen president of the Los Angeles group. Other new officers: **Ben E. Parsons,** retired executive of General Petroleum Corp., honorary vice president; **Fremont R. Schmieder,** Shell Oil Co., vice president; **Douglass G. Kingman,** General Petroleum Corp., treasurer; **Roland Norris,** Macco Corp., sergeant-at-arms; **Paul Andrews,** Signal Oil & Gas Co., historian; **R. Sneddon,** secretary; and **Tom E. Morton,** Halliburton Oil Well Cementing Co., chairman of arrangements.

G. R. BOND

Gerald R. Bond, since 1954 a sales representative in National Supply Co.'s northwest division, Denver, has been named production equipment sales manager. He succeeds **Thomas B. Herndon,** recently promoted to manager of oil-field sales. Bond, a petroleum engineering graduate, joined National Supply in 1950 as warehouseman in Casper, Wyo.

Douglas E. White has been promoted by Magnolia Pipe Line Co., Dallas, from maintenance superintendent to assistant chief engineer. **Charles R. McKenny** moves up from assistant maintenance superintendent to succeed White. **Doyle F. Mapes,** who has been general maintenance foreman, succeeds McKenny.

Hugh N. Frenzel, of Ralph Lowe, Midland, Tex., has been elected chairman of the Permian basin section, Society of Economic Paleontologists and Mineralogists. Other new 1956-57 officers: **Frank W. Dameron,** BBM Drilling Co., Midland, first vice president; **Frank Conselman,** Abilene, Tex., independent, second vice president; **Tom Schneider,** Midland independent, secretary; and **Ed A. Vogler,** Shell Oil Co., Midland, treasurer.

L. J. Autin has resigned as geologist for Gulf Refining Co. to join Plymouth Oil Co. as regional geologist in New Orleans.

John A. Pederson, Shell Oil Co. petroleum engineer, has been transferred from Glendive to Billings, Mont.

J. J. RASOR

J. J. Rasor, assistant manager of The Texas Co.'s natural-gas liquids division since its creation in 1952, has been promoted to manager. He succeeds **M. J. Adams,** who retired March 1 after 33 years' service. Rasor joined Texaco on a summertime basis before graduation from college in 1928. From 1947 to 1952 he was assistant superintendent at the West Tulsa works.

D. J. Cardin has been promoted by Murphy Corp. from district production foreman in Shreveport to the production staff in El Dorado, Ark.

R. W. Blackburn, Continental Oil Co. engineer, has been transferred from Kilgore to Conroe, Tex.

R. A. Broomfield, Jr., formerly with Sohio Petroleum Co. in Bartlesville, Okla., has become an Independence, Kans., consultant.

Larry S. Melzer has resigned as geologist and engineer for Statex Petroleum Co. in Midland, Tex., to become a consultant there.

Lysle A. Gust, Carter Oil Co. engineer, has been transferred from Carmi, Ill., to Tulsa.

O. C. JOHNSON

Oliver C. Johnson has been promoted by Socony Mobil Oil Co., Inc., from manager of the East St. Louis refinery to assistant general manager of manufacturing in New York. **Harry Lutz,** who has been Johnson's assistant, will succeed him in East St. Louis. Johnson joined Socony in 1934 as a chemical engineer. Lutz has been with the firm since 1939.

Ward M. Clark has resigned as engineer with Tennessee Gas Transmission Co. in Olney, Tex., to join Midwest Oil Corp. in Midland, Tex.

Donald I. Gahagan has resigned as research geologist for Pan American Production Co. to join C. N. Housh, of Houston. Before joining Pan American 8 years ago, Gahagan was with Skelly Oil Co.

William E. Wilson has resigned as field engineer with British-American Oil Producing Co. in Riverton, Wyo., to join Miami Operating Co., Inc., as production engineer in Abilene, Tex.

J. B. (Jim) Taylor, formerly a consulting engineer with John Evans, Midland, Tex., has been named superintendent of W. E. Bakke Oil Co. there.

E. J. Sabalature has been advanced by Gulf Refining Co. from gas engineer in Triumph, La., to plant engineer in Kratz Springs, La.

Frank S. Weagant has resigned as geologist with Standard Oil Co. of California in Bakersfield to join Franco-Western Oil Co. there.

DEATHS

Arthur Glenn McKee, founder of Arthur G. McKee & Co., Cleveland refinery designers, engineers, and constructors, died recently.

Eugene Milburn, 73, California independent, died recently. He had moved from Butte, Mont., where he was a geologist, to Los Angeles in 1925.

Edward Peter Reynolds, 83, head of Petroleum Production Corp., died recently in Los Angeles.

Lawrence N. McGinley, 75, retired drilling contractor, died March 6 in Tulsa. McGinley had been active in the old Glenpool, Cushing, and Bristow fields.

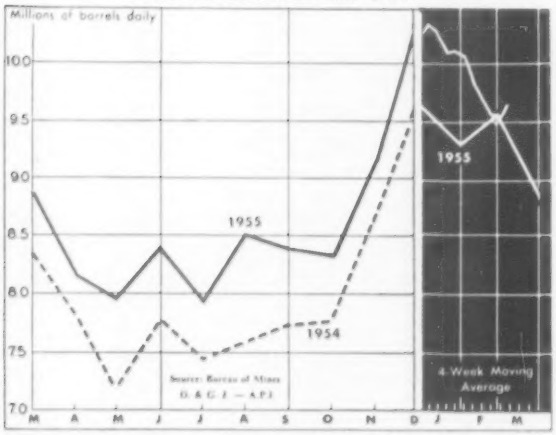
John C. Casper, Economics Editor — CURRENT STATISTICS

Latest Figures . . . Industry Trends

A QUICK LOOK AT THE HIGHLIGHTS

	LATEST WEEK	Change from WEEK AGO		Change from YEAR AGO	
Production	7,174,460	DOWN	5,400	UP	279,436
Crude stocks	258,087,000	UP	2,621,000	DOWN	3,194,000
Completions	919	DOWN	110	NO CHANGE	
Refinery runs	7,982,000	DOWN	111,000	UP	506,000
Gasoline stocks	195,669,000	UP	741,000	UP	12,245,000
Kerosine stocks	18,269,000	DOWN	272,000	DOWN	158,000
Distillate stocks	69,739,000	DOWN	1,909,000	UP	5,907,000
Residual stocks	34,865,000	DOWN	1,105,000	DOWN	10,248,000
Four-product stocks	318,542,000	DOWN	2,545,000	UP	7,746,000
Total imports	1,239,900	DOWN	115,700	UP	13,400

TOTAL DEMAND – ALL OILS



Warm Weather Cut February Demand Cold Weather Boosted It Last Year

CURRENT refinery reports indicate that total demand for all products in February dropped slightly below the average for the same month in 1955. Total demand for February 1956 is estimated at 9,560,000 bbl. daily compared with 9,568,000 bbl. daily for February 1955. However, this comparison does not prove that February demand was abnormally low since last month's figures are being compared with a monthly average that cannot be considered typical.

Total demand for all products last month averaged 8.9 per cent more than demand for the full year 1955. For the past 5 years, the average demand for February has been only 4.0 per cent more than demand for full previous years. This comparison shows that February demand this year was better than average despite a slight drop from last year.

Also, any comparison of March demand with the average for March 1955 should take into consideration the relative position of demand a year ago. Total demand for all products in March 1955 averaged 9.2 per cent more than total demand for the entire year 1954, but demand for the full year 1954 was below normal. For the past 6 years March demand has been about 7.7 per cent above previous full-year averages. Since the base year 1954 was subnormal, the gain of 9.2 per cent credited to March 1955 may indicate that demand for the month represented near-normal growth.

Total demand averaged 8,859,000 bbl. daily for March 1955. A gain of 4.5 per cent would raise the demand level to 9,260,000 bbl. daily for this March. Anything above 9,200,000 bbl. daily for March will rate "good."

Cooler weather helps distillate demand . . . No extended periods of cold weather can be expected for the remainder of this heating season, but the recent wave of cold and snowy weather that moved across the northeastern quarter of the nation has tended to strengthen distillate markets at a time when they were beginning to sag.

There have been rumors of small quantities of Group 3 distillate moving out of pipeline terminals at 0.125 cent a gallon under the normal low of 9.25 cents for No. 2 fuel. If all surplus heating oil at pipeline terminals moved out during the short period of cold weather, there will be less pressure for early reductions in distillate prices.

The late snowfall which helped distillate demand may have had the opposite effect on gasoline consumption. Total gasoline demand for week ended March 10 is estimated at 3,800,000 bbl. daily, but most of the change due to snow will show up in the weeks of March 17 and March 24.

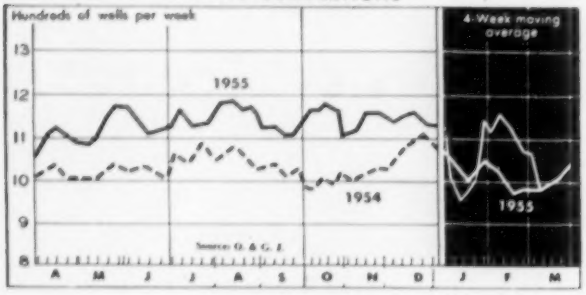
Service-station price wars continue in New England with some expansion reported in the first week of March. The tank-wagon price for regular gasoline in some areas of Rhode Island is down to 12.9 cents a gallon. A supplier in Hartford is selling for 12.65 cents. This grade of gasoline brings 11.00 cents in cargo lots on the Gulf Coast.

Unconfirmed reports this week indicate that the gasoline offered on the Gulf Coast market for the past week or two has been sold at prices slightly under the market.

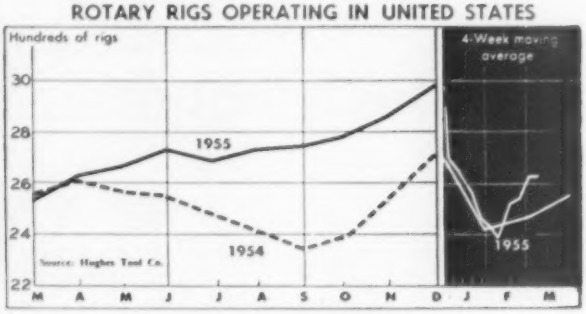
There have been reports, also unconfirmed, that a small amount of Group 3 gasoline is moving out of terminals in Iowa at 10.75 cents plus pipeline charges.

CURRENT STATISTICS — DRILLING

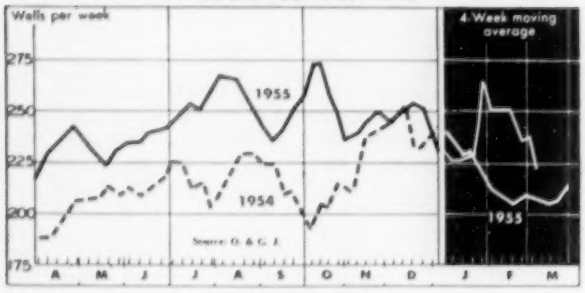
TOTAL COMPLETIONS



ROTARY RIGS OPERATING IN UNITED STATES



WILDCAT COMPLETIONS



ACTIVE ROTARY RIGS*

Area—	3-12-56	Change from 3-5-56	Change from 3-14-55
Gulf Coast	623	—27	48
N. and W. Texas-New Mexico	932	2	75
Arkansas-N. Louisiana-E. Texas	156		—18
Oklahoma	311	9	—15
Kansas-S. Nebraska	183	6	2
Illinois-Eastern	101	14	—23
Rocky Mountain	193	—2	1
Pacific Coast	129	—4	—16
Total United States	2,628	—2	54
Western Canada	244	18	36

*Hughes Tool Co.

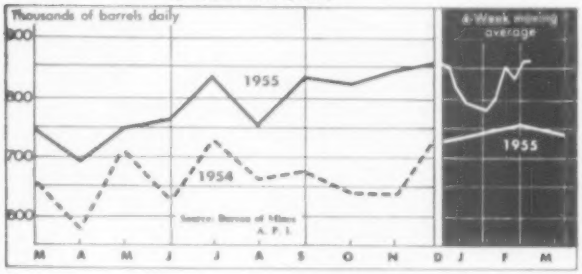
WEEKLY WELL COMPLETIONS . . . WEEK ENDED MARCH 10, 1956

	Total of all wells: Comp.	Oil	Gas	Dry	Footage	Cum. 1956	Cum. 1955	Wildcat completions and discoveries: Oil	Dist.	Gas	Dry	Total	Cumulative total, 1956: Oil	Dist.	Gas	Dry	Total
Ala.-Ga.-Fla.	3	0	1	2	15,013	21	24	0	0	1	1	2	0	0	1	12	13
Arkansas	13	4	0	9	42,995	124	97	0	0	0	5	5	7	0	1	23	31
California	42	31	1	10	169,093	392	450	0	0	0	7	7	7	0	0	72	79
Colorado	17	3	1	13	93,964	226	239	0	0	0	8	8	4	0	3	102	109
Illinois	37	21	0	16	90,041	692	717	0	0	0	8	8	9	0	0	102	111
Indiana	3	0	0	3	2,175	111	125	0	0	0	1	1	3	0	1	25	29
Kansas	89	43	6	*40	305,048	925	951	4	0	0	6	10	20	1	6	157	184
Kentucky	20	9	0	11	21,841	332	249	0	0	0	9	9	8	0	0	82	90
Louisiana	62	35	4	23	433,949	772	718	1	1	0	12	14	21	13	5	104	143
North	28	14	4	10	122,767	286	381	1	0	0	6	7	6	0	0	34	40
South	31	19	0	12	281,979	390	337	0	1	0	5	6	14	12	3	62	91
Offshore	3	2	0	1	29,203	96		0	0	0	1	1	1	1	2	8	12
Michigan	8	5	0	3	25,816	98	114	0	0	0	2	2	3	0	0	30	33
Mississippi	10	3	1	6	70,733	87	85	0	0	1	3	4	4	0	1	32	37
Montana	7	4	1	2	37,673	75	69	1	0	0	0	1	5	0	0	18	23
Nebraska	20	9	0	11	111,381	175	104	2	0	0	8	10	9	0	0	82	91
New Mexico	25	12	9	4	100,268	359	214	0	0	0	3	3	7	0	5	33	45
Northwest	13	2	9	2	43,705	132	54	0	0	0	2	2	0	0	5	12	17
Southeast	12	10	0	2	56,563	227	160	0	0	0	1	1	7	0	0	21	28
North Dakota	3	1	0	2	20,323	43	34	0	0	0	2	2	2	0	0	10	12
Ohio	13	5	0	8	40,210	207	202	0	0	0	0	0	1	0	0	2	3
Oklahoma	147	88	4	55	481,297	1,661	1,469	2	0	0	11	13	32	5	4	143	184
Pennsylvania-New York	8	0	7	1	46,896	145	332	0	0	0	0	0	0	0	1	2	3
Texas	365	240	13	112	1,645,202	4,016	3,559	16	1	5	68	90	168	11	42	905	1,126
Southwest (1 & 4)	80	43	4	33	341,956	607	571	7	1	2	23	33	35	3	14	198	250
Gulf Coast (2 & 3)	41	20	6	15	267,354	508	479	2	0	2	10	14	13	7	16	133	169
East (5 & 6)	15	6	3	6	70,063	234	203	0	0	1	5	6	1	1	3	88	93
North Central (7-B & 9)	113	70	0	43	387,567	1,358	1,213	5	0	0	18	23	76	0	1	315	392
West (7-C & 8)	104	90	0	14	540,781	1,093	897	2	0	0	12	14	39	0	6	160	205
Panhandle (10)	12	11	0	1	37,481	216	196	0	0	0	0	0	4	0	2	11	17
Utah	2	0	0	2	19,478	16	11	0	0	0	2	2	1	0	0	12	13
West Virginia	9	1	6	2	26,799	122	124	0	0	1	1	2	0	0	1	2	3
Wyoming	15	12	1	2	64,487	153	171	1	0	0	1	2	3	0	4	45	52
Miscellaneous (S. D.)	1	0	0	1	4,780	46	7	0	0	0	1	1	4	0	0	34	38
Total United States	**919**	526	55	338	3,869,462	10,798	10,065	27	2	8	159	**196**	318	30	75	2,029	2,452
Total previous week	1,029	532	71	426	4,406,325			24	0	7	224	255	291	28	67	1,870	2,256
Total March 12, 1955	919	533	53	333	3,682,107			27	4	6	168	205	285	32	61	1,735	2,113
Cumulative 1956	10,798	5,866	705	4,227	44,678,502												
Western Canada	337	29	0	8	182,701	418											

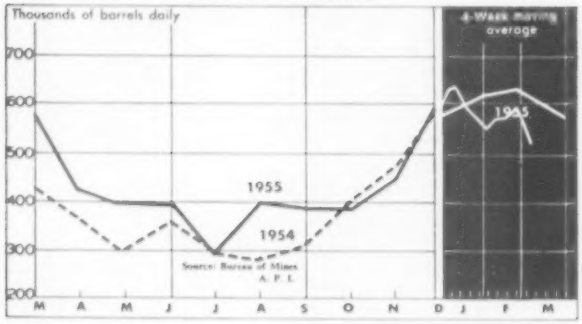
Service wells included: *5, 117.

CURRENT STATISTICS — SUPPLY

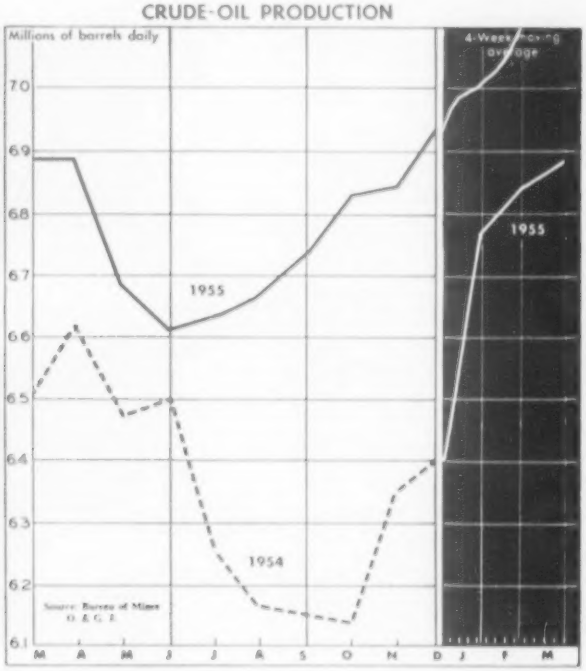
CRUDE IMPORTS



PRODUCT IMPORTS



CRUDE-OIL PRODUCTION

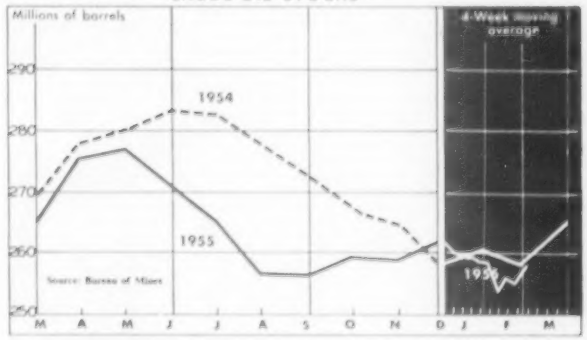


DAILY AVERAGE PRODUCTION FOR WEEK

	March 10			Mar. 3
	Crude oil	Lease condensate	Total	total
Alabama	4,200		4,200	4,300
Arkansas	74,250	450	74,700	74,250
California	970,300		970,300	971,500
Colorado	156,200		156,200	161,300
Eastern	49,600		49,600	49,000
Florida	1,400		1,400	1,375
Illinois	234,900		234,900	231,300
Indiana	31,700		31,700	32,400
Kansas	340,500		340,500	341,200
Kentucky	46,800		46,800	45,900
Louisiana	749,050	72,200	821,250	814,650
North	119,050	2,200	121,250	121,800
South	630,000	70,000	700,000	692,850
Michigan	29,800		29,800	29,600
Mississippi	106,100	4,700	110,800	111,100
Montana	50,900		50,900	50,200
Nebraska	29,900		29,900	29,400
New Mexico	242,025	3,175	245,200	238,875
North Dakota	38,300		38,300	39,800
Oklahoma	618,400		618,400	629,500
Texas	2,974,500	53,900	3,028,400	3,031,100
Dist. 1	54,000	550	54,550	53,825
Dist. 2	151,000	8,450	159,450	159,450
Dist. 3	431,000	25,300	456,300	463,450
Dist. 4	247,000	5,400	252,400	251,675
Dist. 5	47,000	500	47,500	47,150
Dist. 6	130,000	6,200	136,200	136,200
East Texas field	220,500		220,500	222,850
Dist. 7-B	163,000	50	163,050	158,050
Dist. 7-C	177,000	4,700	181,700	183,125
Dist. 8	1,050,000	1,950	1,051,950	1,051,950
Dist. 9	210,000	600	210,600	209,900
Dist. 10	94,000	200	94,200	93,475
Utah	6,250		6,250	6,600
Wyoming	284,600		284,600	286,300
Others	2350	§10	360	210
Total U. S.	7,040,025	134,435	**7,174,460**	7,179,860
Change from previous week, down			**5,400**	
Canada	‡397,550		‡397,550	‡452,550
Total U. S. production January 1-March 10			495,684,420 bbl.	
Same period last year (crude plus cond.)			*469,651,360 bbl.	

*Includes 7,963,050 bbl. condensate. †Week ended previous Monday. ‡Nev. 250, S. D. 100. §Arizona.

CRUDE-OIL STOCKS



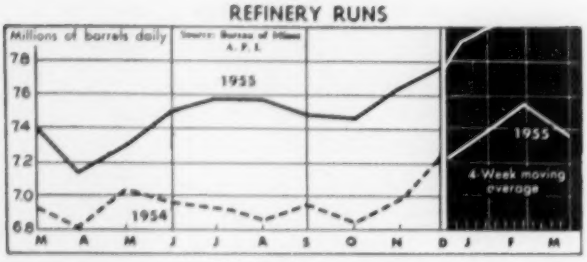
CRUDE-OIL STOCKS BY STATES OF ORIGIN*

(Thousands of barrels)

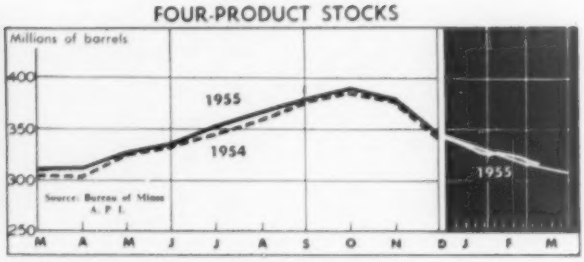
	3-3-56	2-25-56	3-5-55
Pennsylvania Grade	2,746	2,716	2,804
Other Appalachian	1,815	1,927	1,996
Illinois, Indiana, Michigan	9,476	9,452	11,375
Nebraska, North Dakota	2,066	2,055	1,815
Kansas	7,957	7,933	8,334
Oklahoma	22,638	22,594	24,073
Arkansas	2,390	2,198	2,943
Louisiana	16,038	16,667	14,140
North	2,475	2,493	2,558
South	13,563	14,174	11,582
Mississippi	3,076	2,938	3,102
New Mexico	8,286	8,166	8,465
Texas	122,281	120,267	118,951
East Texas proper	9,098	9,648	10,527
West	59,800	59,092	52,120
Texas Gulf	22,289	21,611	23,572
Other Texas	31,094	29,916	32,732
Wyoming	15,106	15,033	13,751
Other Rocky Mountain	5,280	5,220	5,338
California	28,021	27,069	32,353
Foreign	†10,911	11,231	11,841
Total	258,087	255,466	261,281

*Bureau of Mines. †Includes 1,545,000 bbl. in California.

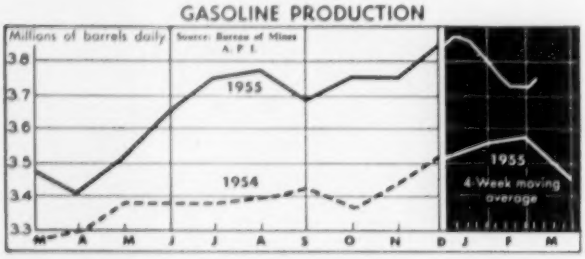
REFINERY RUNS



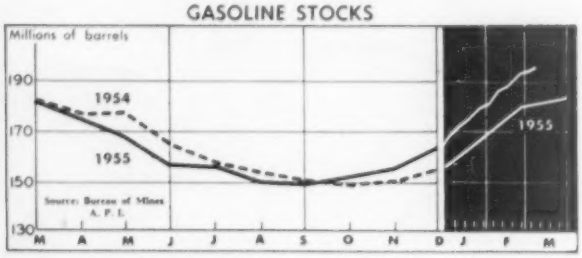
FOUR-PRODUCT STOCKS



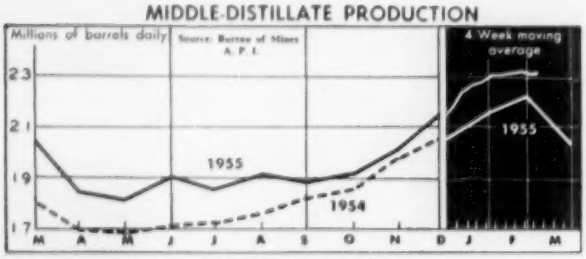
GASOLINE PRODUCTION



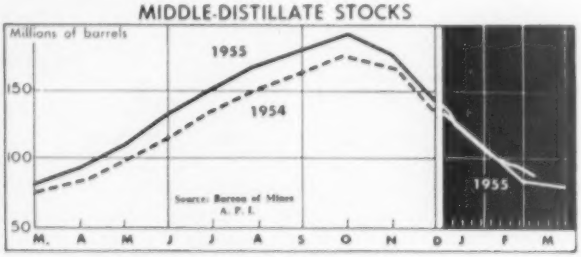
GASOLINE STOCKS



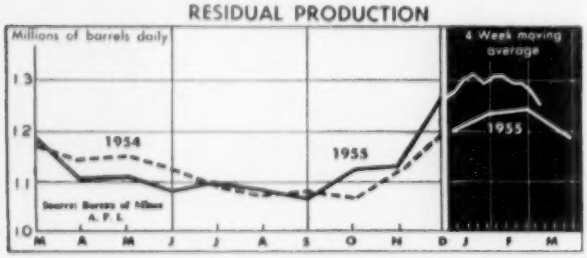
MIDDLE-DISTILLATE PRODUCTION



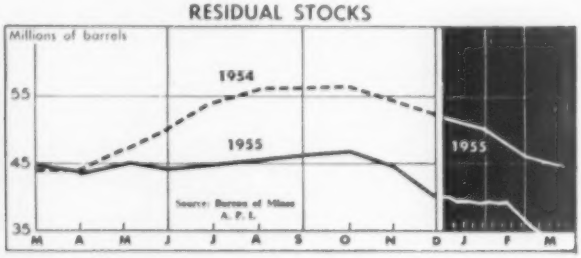
MIDDLE-DISTILLATE STOCKS



RESIDUAL PRODUCTION



RESIDUAL STOCKS



A.P.I. REFINERY REPORT, MARCH 9

(Thousands of barrels)

District—	Daily avg. runs	Daily average production Gaso.*	Kero.	Dist.	Resid.	Stocks† Gaso.†	Kero.	Dist.	Resid.	Bureau of Mines, March 1955 Daily avg. runs	Daily average production Gaso.*	Kero.	Dist.	Resid.
East Coast	1,152	482.6	39.1	307.6	215.1	38,542	8,345	25,225	10,255	1,102	437.2	40.4	306.4	244.5
Appalachian:														
District 1	109	44.4	3.7	29.0	9.7	4,932	406	1,427	400	98	41.2	5.2	25.2	9.1
District 2	108	52.3	7.9	21.9	19.6	3,122	329	656	250	91	47.7	6.6	19.3	15.1
Ind., Ill., Ky.	1,465	714.0	73.7	325.7	173.1	41,091	3,730	11,886	3,480	1,394	707.5	80.1	312.6	190.2
Okla., Kans., Mo.	769	421.4	26.0	204.6	29.4	22,799	733	7,355	926	670	380.0	19.0	171.5	45.4
Inland Texas	274	182.1	8.9	55.3	27.1	7,408	354	1,158	1,372	258	182.6	11.4	52.6	18.2
Texas Gulf Coast	1,938	927.3	133.1	555.1	257.7	29,239	2,236	6,915	5,454	1,894	843.4	130.6	525.8	243.5
La. Gulf Coast	704	328.7	62.9	194.3	60.3	10,098	1,165	3,497	1,674	645	305.3	60.5	165.7	39.8
N. La. and Ark.	71	27.1	5.6	20.0	3.9	4,678	476	1,058	74	94	33.9	10.7	21.9	6.7
Rocky Mountain:														
New Mexico	20	9.4		3.3	2.3	288	9	61	29	20	11.4	0.5	3.0	2.7
Other Rocky Mtn.	278	134.0	5.7	69.4	43.9	8,110	240	2,318	802	256	119.9	4.6	62.9	40.0
California	1,094	480.6	3.6	153.1	352.9	25,362	246	8,183	10,149	1,027	456.9	4.4	180.2	383.5
Mar. 9, 1956	7,982	3,804.0	370.1	1,939.0	1,195.0	195,669	18,269	69,739	34,865	7,549	3,567.0	374.0	1,847.1	1,238.7
Mar. 2, 1956	8,093	3,733.1	386.7	1,886.9	1,260.9	194,928	18,541	71,648	35,970					
Mar. 11, 1955	7,476	3,514.4	368.4	1,777.6	1,218.9	183,424	18,427	63,832	45,113					

*At refineries including natural blended. †Finished and unfinished. ‡At refineries, bulk terminals, in transit, and in pipelines.

Crude-oil and refinery prices at representative U. S. and foreign points

REFINED-PRODUCT PRICES

Following quotations are for refinery products in cents per gallon moving in interstate shipments on Wednesday each week unless otherwise noted. Crude-oil prices are per barrel at the wells unless otherwise listed.

GASOLINE*

Mid-Continent (Group 3):	
Regular (86 octane)	11.00-11.25
Premium (94 octane)	12.50-12.75
Gulf Coast (Cargoes for coastwise or export movement):	
Regular (90 octane)	11.00-11.25
Premium (97 octane)	13.00-13.25
New York (barges):	
Regular (89 octane)	12.25
Premium (96 octane)	14.50
California—Los Angeles (rack):	
Regular (84 octane)	12.75-13.15
Premium (93 octane)	14.10-15.10
Caribbean area (cargoes):	
Regular (87 octane)	10.50
Premium (93 octane)	11.50

*Quotations are for octanes shown. Prices usually vary with octane ratings within the regular, premium, and aviation grades.

NATURAL GASOLINE*

Group 3:	
Grade 26-70	5.0
Breckenridge:	
Grade 26-70	..5

*If 26-70 natural is considered as 100 per cent, prices for lower-vapor-pressure grades increase 2.5 per cent for each unit drop in Reid vapor pressure down to and including 16-lb. Prices for grades below 16-lb. may vary slightly by areas or plants.

KEROSINE AND DISTILLATE

Mid-Continent (Group 3):	
Kerosine 42-44	10.25-10.375
Diesel oil (58 d.i. and above)	9.875-10.00
Distillate No. 1	9.875-10.00
Distillate No. 2	9.25-9.375
Gulf Coast (cargoes):	
Kerosine 41-43	9.5-9.625
Distillate No. 2	9.00-9.25
New York Harbor (barges):	
Kerosine 41-43	10.85
Distillate No. 2	10.35
Diesel fuel, 48-52 d.i.	10.65
Caribbean area (cargoes):	
Distillate No. 2	9.00

WAX (LB.)

Oklahoma (Group 3):	
132-135 A.m.p. (semi-refined) in tank cars	6.50
New York (export):	
126-130 A.m.p. crude scale (solid in bags or barrels)	7.10

★ Denotes change from previous week.

RESIDUAL FUEL (BBL.)

Mid-Continent (Group 3):	
Residual fuel (max. 1% S)	$2.10-2.20
Gulf Coast (cargoes):	
Bunker C fuel	$2.10
New York Harbor (barges):	
Bunker C fuel	$2.65
Caribbean (cargoes):	
Bunker C at Aruba, N.W.I.	$2.10
California (rack):	
Bunker C fuel, Los Angeles	$2.10-2.20

LUBRICATING OILS

Mid-Continent (Group 3):	
150-160 bright stock, solvent refined, 0-10 p.p., 95 v.i.	24
200 vis. neutral oil, solvent refined, 0-10 p.p., 95 v.i.	20.75
Pennsylvania Grade:	
145-155 vis. at 210, bright stock, 8 color, 25 p.t.	23.5
200 vis. neutral (180 at 100°), 25 p.t.	20

CRUDE-OIL PRICES

GRAVITY SCHEDULE

	Signal Hill, Calif.	Mid-Cont.*	Gulf Coast Tex.†	West Tex.‡ N.M.	Wyo. (sour)
14-14.9	$2.02				
15-15.9	2.08				
16.16.9	2.13				
17-17.9	2.19				
18-18.9	2.24				
19-19.9	2.30				
20-20.9	2.35	$2.50		$2.37	
21-21.9	2.41	2.52		2.39	
22-22.9	2.47	2.54		2.41	
23-23.9	2.52	2.56		2.43	
24-24.9	2.58	2.58	$2.91	2.45	
25-25.9	2.64	2.60	2.93	2.47	
26-26.9	2.69	2.62	2.95	2.49	
27-27.9	2.76	2.64	2.97	2.51	
28-28.9	2.83	2.66	2.99	2.53	
29-29.9	2.91	2.68	3.01	2.55	
30-30.9	2.97	2.70	3.03	2.57	
31-31.9	3.04	2.72	3.05	2.59	$2.46
32-32.9	3.12	2.74	3.07	2.61	2.48
33-33.9	3.20	2.76	3.09	2.63	2.50
34-34.9	3.27	2.78	3.11	2.65	2.52
35-35.9	3.34	2.80	3.13	2.67	2.54
36-36.9	3.39	2.82	3.15	2.69	2.56
37-37.9		2.84	3.17	2.71	2.58
38-38.9		2.86	3.19	2.73	2.60
39-39.9		2.88	3.21	2.75	2.62
40 and up		2.90	3.23	2.77	2.64

*Includes Oklahoma, Kansas, North Dakota, West Texas (sweet), North Central Texas, North Louisiana, Arkansas, and Wyoming (sweet). †Low-cold-test Gulf Coast. ‡Sour.

Effective dates: California, February 7, 1956; east of California, June 15, 1953; Pennsylvania Grade, February 6, 1956.

FLAT PRICES

Louisiana:	
Cotton Valley (distillate)	$3.00
Cotton Valley (Holloway crude)	2.95
Texas:	
East Texas	2.90
Chapel Hill	2.83
Conroe	3.13
Van	2.73
Pennsylvania Grade:	
Bradford	4.00
Middle District	3.87
Southwest Pennsylvania	3.58
West Virginia	3.46
Buckeye Grade	3.40
Zanesville Grade	2.97
Illinois Basin	3.00
Canada:	
Leduc-Woodbend (flat prices D-2, D-3)	2.60
Redwater (Alta.) D-3	2.49
Smiley-Viking (Sask.)	2.26
Fosterton (Sask.)	1.29
Pembina	2.52

FOREIGN

Venezuela:	
Cumarebo, 48°-48.9°, Tucupido	*$3.40
San Joaquin, 41°-41.9°, Puerto La Cruz	*3.04
Oficina, 35°-35.9°, Puerto La Cruz	*2.80
Tia Juana medium, 26.5°-26.9°, Amuay	†2.30
Quiriquire, 16.5°-16.9°, Caripito	‡2.21
Lagunillas heavy, flat, Amuay or Las Piedras§	2.05
Bachaquero, 16.5°-16.9°, Amuay or Las Piedras§	‡1.90

*Plus or minus 2 cents per barrel for each degree gravity change. †Plus or minus 2.5 cents per barrel for each half-degree gravity change. ‡Plus or minus 3.5 cents per barrel for each half-degree gravity change. §Also available at La Salina at 3.0 cents per barrel less.

Middle East, Persian Gulf (cargoes, f.o.b. lifting port):	
Arabian, 36.0°-36.9°, Ras Tanura	$1.97
Iranian, 34.0°-34.9°, Bandar Mashur	1.91
Iranian, 34.0°-34.9°, Abadan	1.86
Iraq, 36.0°-36.9°, Fao	1.87
Kuwait, 31.0°-31.9°, Mina-al-Ahmadi	1.72
Qatar, 39.0°-39.9°, Umm Said	2.06
Middle East, E. Mediterranean:	
Arabian, 36.0°-36.9°, Sidon	2.46
Iraq, 36.0°-36.9°, Tripoli, Banias	2.46
Far East (cargoes, f.o.b. Lutong, Sarawak):	
Seria Light, 37°-38°	2.60

TANKER RATES (PER LONG TON)

(Latest reported spot fixtures)

Gulf-U.S.N.H., clean (USMC—10%)	$2.56
NWI-U.S.N.H., dirty (USMC—10%)	2.43
NWI-U.K., clean (Scacle +22.5%) (39s. 10d.)	5.59
NWI-U.K., dirty (Scale +17.5%) (38s. 2d.)	5.35
Persian Gulf-U.S.N.H., dirty (U.S.M.C.—12.5%)	11.11
Lebanon-France, dirty (USMC flat)	5.45

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WE HAVE ON HAND in Montgomery, Alabama, the following steel pipe for sale: 200 Ft. 12¾" .330 Wall, Grade B, Specification API5 L @ $4.64 Ft. 7200 Ft. 8⅝" O.D. .277 Wall, 24.7 lbs. per foot, Specification API 5LX, Grade X42 @ $2.14 per Ft. 1670 Ft. 6⅝" O.D. .280 Wall, 18.97 lbs. per foot. Specification API 5L, Grade B @ $1.67 per Ft. 360 Ft. 4½" O.D. .237 Wall, 10.79 lbs. per foot, Specification API 5L, Grade B @ $1.01 per Ft. 2600 Ft. 3½" O.D. .216 Wall, 7.58 lbs. per foot, Specification API 5L, Grade B @ $ .75 per Ft. This pipe, manufactured by National Tube Division, U. S. Steel Corporation, is all seamless tubing and has been coated and wrapped to J. W. Goodwin Engineering Company specifications. R.F.D. 6—Box 21, Montgomery, Alabama.

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Worth. 12" KUF Diesel drive.
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4'x59' 160 PSI 23 trays.
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ELI DRILL M6D-164-D on 1948 Ford. New Motor, good rubber. 22' Mast, 13' Kelly. 4½ x 5 GD Pump, 150' Rod. May be seen at Failing Lot, Enid, Oklahoma. SeisDrill, Inc., 515 Thompson Bldg., Tulsa, Oklahoma.

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Line Pipe, #1 Used
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1952 CARDWELL, 5000' Capacity, (complete). Includes: Model D 51 Drawworks with 400 HP Transmission, compounded. Powered with one set of 671 GM Twin Motors. 7¼"x12" Gardner-Denver Pump. 87' Lee C. Moore Mast. 17½" Gumbo Buster Oil Bath Rotary Table. Two (2) 5¾" x 30' Drill Collars.
PRICE $50,000.00.
BOX J-439,
THE OIL AND GAS JOURNAL,
TULSA, OKLAHOMA.

FOR SALE EQUIPMENT

FOR SALE—High Pressure Separator, National Tank Company, Serial No. 4584, Model 4B61,2125 # WP—2125#, Weight 13,200 lbs. $950.00. Jackson, 405 Meadows Bldg., Dallas, Texas, Phone FO 8-8817.

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600 hp IR KVG Gas Comp.
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1 BJ 8" Pump, 2000 gpm 115' hd.
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7'6" x 55' 30 trays 45 lb.
8' x 75' 25 tray 40#
2' x 60' 35 tray 560#

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Lab Petro-chem furnace 50,000 BTU/hr.

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2—10' x 40' hor wld. tanks
1—10' x 40' tank 30# WP.
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3—800# 20 MMCF Absorbers with Scrubbers, etc.
1—Fluor "Counterflo" Induced Draft Cooling Tower Complete.

Other equipment, Instruments, Pumps, Pipe, Valves and Fittings necessary in Gasoline Plant Construction. Detailed Inventory Available upon request.

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Used A-1 condition

Measurements: 15½"—10' long—⅛" thick
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For Complete Information
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FOR SALE—2 truck mounted Bettis steam units. Good condition, equipped for oil field work. Box J-332, The Oil and Gas Journal, Tulsa, Oklahoma.

FOR SALE: Wilson Double drum Mogul Drawworks Serial 6252 with 6-GAK-3 Waukesha engine. Bellaire Pipe & Supply Co., 8020 Lyons Ave., Houston 20, Tex. Phone OR-4-2763.

FAILING 1500 heavy duty drill with 4½ x 5 pump, automatic pulldown, and mounted on Ford truck. Write P. O. Box 819, Longmont, Colo. Phone 1333.

GAS COMPRESSORS: 90 Horsepower Superior on skids. Complete packaged unit. Five Type 80 twin Coopers. Alfred B. Kern, 343 Kennedy Bldg., Tulsa, Okla.

ROLAGRIP COUPLINGS:—For sale, 2" and 3", complete with bolts and gaskets. Never in use. Quantity of each size. Box J-427, The Oil and Gas Journal, Tulsa, Oklahoma.

FOR SALE—Near Madison, Kansas: 4 miles 2" beveled range 1, #1 grade used line pipe, 25 cents per ft., clean inside and out. Cities Service Oil, Patridge, Bartlesville, Oklahoma.

HIGHLY PORTABLE 3000 foot rotary complete. Almost new. Trucks, float, welder, etc. $35,000. Frontier, Oil Gas Building, Houston. HO 5-3965.

SMALL "FAILING" Rotary Drill with pump, on Ford F-6 truck, with or without equipment. Contact O. C. Thatcher, Stanford, Montana.

EQUIPMENT WANTED

ROCKWELL INTEGRATOR, Serial Number Two Hundred and Higher. Box J-432, The Oil and Gas Journal, Tulsa, Oklahoma.

HELP WANTED

GAS ACCOUNTANT with several years experience in general and gas accounting and some experience in supervising personnel—about 35 years age. Box J-391, The Oil and Gas Journal, Tulsa, Oklahoma.

FOREIGN EMPLOYMENT

The Arabian American Oil Company has immediate job openings for unmarried males with minimum 5 years' experience in the following classifications:

BOILER FIREMAN
High pressure boiler experience.

TURBINE OPERATOR
Electric power generation experience.

ELECTRICIAN
Heavy industrial construction and maintenance experience.

MACHINIST
Inside and outside experience.

INSTRUMENT REPAIRMAN
Oil refinery or chemical processing experience.

CHEFS
Large scale institutional, restaurant or construction camp experience.

Write outlining personal history and work experience.

Recruiting Supervisor, Box 122

ARABIAN AMERICAN OIL COMPANY

505 PARK AVENUE
NEW YORK 22, NEW YORK

HELP WANTED

GEOLOGISTS—Two to four years experience for work in Gulf Coast Area. Salary commensurate with experience. Replies confidential. Lion Oil Company, a Division of Monsanto Chemical Company, P. O. Box 1907, Shreveport, Louisiana.

ENGINEER—Gas transmission company in Rocky Mountain area needs Junior Engineer for pipeline and meter station design, material specification and expediting. Work in Engineering Department with experienced Engineers on above problems as well as sizing pipelines, gathering system studies, pipeline efficiencies and revision of existing pipelines. Starting salary $425.00. Permanent employment with liberal employee benefits. Submit details of qualifications and experience to Box J-436, The Oil and Gas Journal, Tulsa, Oklahoma.

OIL FIELD SERVICE ENGINEERS

Mechanical or Petroleum Engineers with some field experience. Men without degrees but with two years rotary or workover rig experience may qualify. High school diploma or equivalent required. Age under 35 preferred. Good pay with excellent fringe benefits. Automobile and expenses.

Contact

BAKER OIL TOOLS, INC.
P. O. Box 3048
HOUSTON 1, TEXAS

HELP WANTED

SALES ENGINEER (New Product)

Graduate petroleum, mechanical or chemical engineer with petroleum experience needed for interesting assignment to assist in development and promotion of new equipment for use in petro-chemical industry. Should be familiar with oil processing equipment, design and application. Work will include personal contact with major oil companies. Sales experience helpful.

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DORR-OLIVER INCORPORATED
2900 Glascock St.
Oakland 1, California.

ENGINEERS

Major Oil Company has openings in drilling, production & pipe line departments in Venezuela for graduate petroleum, mechanical & civil engineers. Salary commensurate with experience. Please send details of experience to:

P. O. Box #35
Bowling Green Station
New York 4, New York

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SOUTH AMERICA

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Will plan, schedule and coordinate oil refinery maintenance and construction projects and/or provide technical assistance to refinery crafts.

PROJECT ENGINEERS:
Assignments may include project development, cost estimation, materials specifications, design and drafting, and construction follow-up.

PROCESS ENGINEERS:
Work assignments may involve process design and control, economic studies, and/or scheduling of refinery operating programs.

EQUIPMENT INSPECTION ENGINEERS:
Will inspect refinery equipment and request equipment renewals when necessary due to corrosion or failure under safty codes.

Engineering degree and minimum of two years experience in oil refinery or allied chemical industry required.

Liberal salaries, benefit plans, and vacation policy.

WRITE

Giving complete address, age, marital status, education and details of previous experience. Box 308-L, Radio City Station, New York 19, N. Y.

HELP WANTED

SEISMIC COMPUTERS and Surveyors for Field Parties in Oklahoma, West Texas. Republic Exploration Company, Box 2208, Tulsa.

WANTED

Experienced Toolpushers and Drillers

Well established Drilling Contractor planning large expansion in offshore operations cannot fill all anticipated vacancies from organization.

Top wages, excellent benefits, good equipment, good working conditions and opportunity for advancement for those accepted.

Only those with mature judgment and excellent supervisory ability who can furnish us a record of deepwell experience on the Gulf Coast need apply.

Send letter giving qualifications, experience and references to:

Box J-425, The Oil and Gas Journal, Tulsa, Oklahoma.

ADMINISTRATIVE ASSISTANT

Independent oil company has opening for young administrative assistant who has an oil background either in drilling or production. Will work as assistant to Manager of Operations. Must be capable of handling administrative details; preferably Business Administration graduate. Good personality essential, age limit under 35. In replying, give past employment record and educational background. All replies handled strictly confidential. Reply

Box J-395,

The Oil and Gas Journal,

Tulsa, Oklahoma.

HELP WANTED

DRILLING SUPERINTENDENT—An established well known Drilling Company has an opening in the Rocky Mountain area for a man with five years experience as a Rotary Driller on power rigs, two years as a Tool Pusher, and a minimum of two years college. Must be capable of supervising all emergencies, such as fishing jobs, blow outs, lost circulation, coring, testing, etc. Write giving age education, marital status, and complete details of experience. Box J-404, The Oil and Gas Journal, Tulsa, Oklahoma.

DRILLERS

Experienced oil well drillers wanted immediately for work in Middle East. Good salaries, all expenses paid. Six months contract. Cannot take families. Apply Box J-434, The Oil and Gas Journal, Tulsa, Oklahoma, giving previous employment record and references.

CHEMICAL ENGINEERS

For responsible staff positions in New York Office directing the work of groups of experienced engineers doing process evaluation and design, economic studies and related work on refining and crude oil handling facilities, together with supporting power plants and other utilities. Work entails occasional trips of short duration to Europe and Middle East. Chemical Engineering degree plus 5 years' process experience, preferably in petroleum.

Salary commensurate with training and work experience. Liberal benefit program. Write giving full particulars regarding personal history and work experience. Please include telephone number.

Recruiting Supervisor, Box 100

ARABIAN AMERICAN OIL COMPANY

505 Park Ave., New York 22, N. Y.

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WILLIAM H. WEBER

Sohio Pipe Line Company

7438 Forsyth — St. Louis 5, Missouri.

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For modern, independent oil refinery located near St. Paul, Minn. He will report directly to the company treasurer and will be in charge of budgeting, statistics, economic analysis, and the preparation of profit and loss and production forecasts.

A Bachelor of Science degree in Chemical Engineering desirable. Should be a graduate of an accredited university business school. At least two years experience required in refinery petroleum economics.

Furnish complete resume of experience and education including salary requirements. All replies confidential. Write or apply in person:

GREAT NORTHERN OIL COMPANY

PINE BEND REFINERY

P. O. Box 3596

SAINT PAUL 1, MINNESOTA

HELP WANTED

EMULSION PLANT SUPERVISOR. Venturing into asphalt emulsions and have opening for man thoroughly experienced in this field. Preferably under 35 years of age. Location Tuscaloosa, Alabama. Submit complete resume of background and experience. Hunt Oil Company, P. O. Box 3053, Dallas, Texas.

ENGINEERS

Houston refinery has openings for Chemical and Petroleum Engineers with refinery experience. Salary open.

Send complete resume to

P. O. Box 5008

Harrisburg Station

Houston 12, Texas

PETROLEUM ENGINEERS

Active independent oil company has vacancies for graduate petroleum engineers with two to five years of practical experience in drilling and production in West, West Central or North Texas. Excellent opportunities for growth and advancement. Replies should furnish complete personal data, education, experience, and starting salary desired.

BOX J-300,

THE OIL AND GAS JOURNAL,

TULSA, OKLAHOMA.

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HELP WANTED

FOREIGN EMPLOYMENT. List of oil companies and drilling contractors showing where to apply for foreign jobs. OIML Co., Box 2603, Tulsa, Okla. $5.00 cash.

PETROLEUM ENGINEER—Gas transmission company in Rocky Mountain area needs Petroleum Engineer in reserves section. B.S. or M.S. degree. Two years experience in general engineering or reservoir engineering. Salary commensurate with experience and training. Permanent employment with liberal employee benefits. Submit details of qualifications and experience to Box J-437, The Oil and Gas Journal, Tulsa, Oklahoma.

Plant Equipment Inspectors

Graduate engineers with minimum 5 years' experience in design or inspection of petroleum processing plants and equipment. Major part of experience must have been in inspection work entailing general knowledge of all facilities. Develop inspection methods, supervise and conduct inspections and advise operations on codes and equipment limitations in a major oil installation located in Saudi Arabia.

Write giving full particulars regarding personal history and work experience. Please include your telephone number.

Recruiting Supervisor, Box 90

ARABIAN AMERICAN OIL COMPANY

505 PARK AVENUE
NEW YORK 22, NEW YORK

SITUATIONS WANTED

PETROLEUM GEOLOGIST; 38, B.S., M.S., approximately six years petroleum experience in Gulf Coast, Texas and California. Desires petroleum exploratory work. Box J-413, The Oil and Gas Journal, Tulsa, Oklahoma.

SEISMIC PARTY CHIEF, good background in Physics and Mathematics plus seven years domestic and foreign experience desires foreign employment with Oil Company or Contractor. Box J-406, The Oil and Gas Journal, Tulsa, Oklahoma.

ECONOMIC ANALYST, ten years experience with major performing economic evaluations of refinery operations. Desires position as comptroller or analyst with progressive small or medium company. Degrees in business administration and engineering. Box J-421, The Oil and Gas Journal, Tulsa, Oklahoma.

OIL OPERATORS—Low temperature separation (glycol injection) and dehydration man with production and well completion experience. Married, 33, employed. Desire to make change. Box J-444, The Oil and Gas Journal, Tulsa, Oklahoma.

GRADUATE PETROLEUM ENGINEER. 35, eleven years drilling and production engineering, (including reserve estimates) in Gulf Coast. Excellent references. Box J-438, The Oil and Gas Journal, Tulsa, Oklahoma.

GEOPHYSICIST—15 years field and 5 years executive domestic and foreign experience. Good organizer. Desires position with permanent base but no objections to traveling. Degree. Box J-442, The Oil and Gas Journal, Tulsa, Oklahoma.

AMBITIOUS Civil Engineer, 32, married, family. Ten years major oil company experience—field and office. Five years general oilfield engineering. Five years design and construction gas processing and compressor installations. Employed. Only positions with managerial potential considered. Box J-443, The Oil and Gas Journal, Tulsa, Oklahoma.

SUBSURFACE GEOLOGIST—B.S., married, 4 years with major, West Texas-New Mexico. Specialize in subsurface mapping and lease evaluation. Desire responsible position with small well-integrated oil company. Box J-433, The Oil and Gas Journal, Tulsa, Oklahoma.

SITUATIONS WANTED

ACCOUNTANT—B.S., M.B.A., C.P.A., 3 years major oil, 4 years public accounting. Desires oil accounting position in Houston. Box J-441, The Oil and Gas Journal, Tulsa, Oklahoma.

REAL ESTATE

FOR LEASE: Warehouse under construction on T&P trackage. Fireproof. Office available. Write Box 1127 or telephone 3-3980, Midland, Texas.

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MAILING LISTS
Royalty Investors. Other oil lists. Oil Industry Mailing List Co., 405 Tuloma Bldg., Tulsa, Okla.

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HIGHEST PRICES PAID for choice oil and gas income royalties, overrides, oil properties. A. S. Berry, P. O. Box 1383, Tulsa, Oklahoma.

LEASE AND DRILLING BLOCKS

CONTACT A. L. Bowles, Box 947, Ada, Okla., for Drilling Deals, Oil Production.

FOR SALE: Three year option on 33,000 acre block in T 11 & 12 S, R 94 W, Delta Co., Colo. $2.50 & 2½% ORR. Good gas possibilities. Box J-379, The Oil and Gas Journal, Tulsa, Oklahoma.

OIL, GAS & URANIUM lease, 78,400 acres New Mexico. Solid tract, one owner. $1.00 per acre bonus, 50c per acre annual rentals 10 commercial lease. Box J-418, The Oil and Gas Journal, Tulsa, Oklahoma.

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Box J-424, The Oil and Gas Journal,
Tulsa, Oklahoma.

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Fort Worth 2, Texas

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5 TO 500 WELLS WANTED. Serious buyer seeks willing sellers with expert reports. Quick action. Strictest confidence. Box J-423, The Oil and Gas Journal, Tulsa, Oklahoma.

WANTED

TO PURCHASE oil production or corporations having production for cash or stock in a listed company (or combination of both). All replies strictly confidential. Box J-412, The Oil and Gas Journal, Tulsa, Oklahoma.

BUSINESS SERVICE

Delaware Corporations formed and serviced. American Guaranty & Trust Company. P. O. Box 487, Wilmington, Delaware.

BUSINESS OPPORTUNITIES

WOULD LIKE a partner for cable tool drilling operation in Oklahoma or Texas. 1261 W. Wardlow Rd., Long Beach, Calif.

HAVE TWO GOOD oil or gas locations and will drill soon. Will sell from 1/64 to ½ interest with wells full completed. Both wells will have good geology. If interested will furnish full information. Best of references. Box J-419, The Oil and Gas Journal, Tulsa, Oklahoma.

DRILLING & EQUIPPING 3 wells Prue Sand Miami Co., Kansas. A ½ W.I. 3 wells $4500, a ½ W.I. 2 wells $3100, in 1 well $1750. All direct offset to present production. Pipeline connection. Write Box 371, Paola, Kansas.

AS AN ENGINEER I am constantly contacting owners of oil and gas properties for sale. Have some excellent deals now in East Texas and Louisiana. Taylor Suite, 618 Kilgore Hotel, Kilgore, Texas.

Manufacturers Agents established 15 years in N.Y.C. interested in expanding activities with one or two additional accounts. Our company can guarantee select account. Complete coverage in metropolitan area for equipment involved in construction and operation of petroleum and chemical plants. Reply

Box J-435, The Oil and Gas Journal,
Tulsa, Oklahoma.

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Box J-416,

The Oil and Gas Journal,

Tulsa, Oklahoma.

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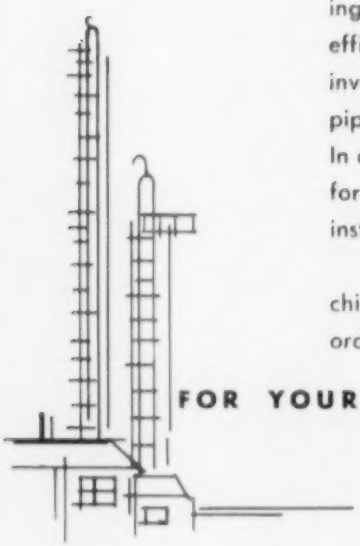

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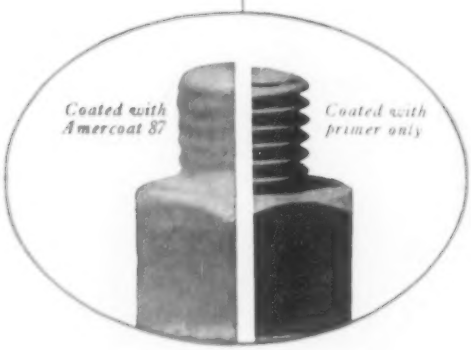


Amercoat 87's thixotropic characteristic helps provide extra thickness on sharp edges and irregular surfaces; it is non-porous and will not crack or check.

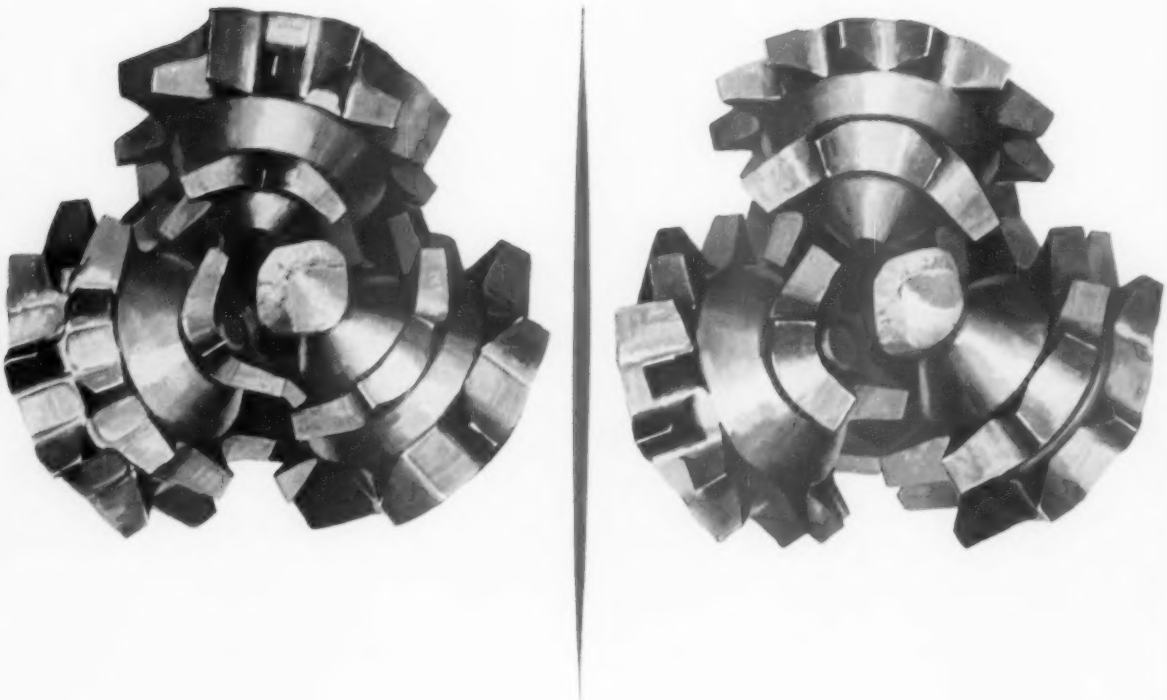
Amercoat 87 combines the time-tested chemical and weather resistance of vinyl coatings with the thickness of conventional mastics, yet is easily applied with standard industrial spray equipment.

We will be pleased to send you our technical bulletin describing this coating in detail.

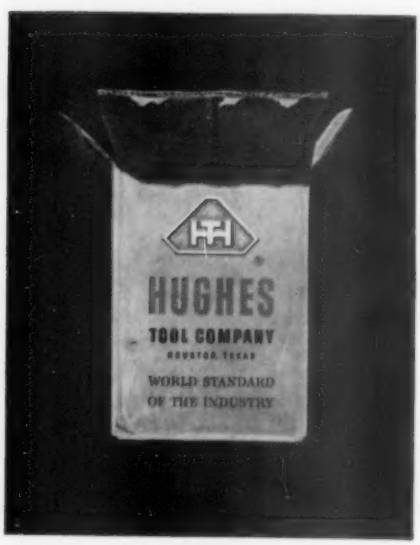
Amercoat
CORPORATION

DEPT. CC, 4809 FIRESTONE BOULEVARD, SOUTH GATE, CALIFORNIA Evanston, Ill. • Kenilworth, N.J. • Jacksonville, Fla. • Houston, Tex.

THEY LOOK ALIKE ... but



there's a difference in their performance



The two rock bits pictured here are excellent examples of the fact that bits that may look alike don't always perform alike.

Both bits are similar in design. But changes have made the second bit a faster cutting, better-performing, more versatile bit ... capable of drilling a wider range of formations.

Hughes bits are undergoing constant improvement based on continuing research and the world's greatest rock bit experience—over one billion feet of hole drilled in the past 47 years. That's why you can depend on HUGHES bits to consistently drill more hole faster!

journal-guide

Supplement to The Oil and Gas Journal, Vol. 54, No. 46, March 19, 1956.

CRUDE-OIL PROCESSING

The production of 100-octane motor gasoline begins with careful processing of crude oil and other feed streams. Vacuum distillation and a residual-treating process will be necessary in most plants. Supplementary feed — natural gasoline and condensate from field-processing operations—will be needed in most refineries.

CRUDE

Natural Gasoline and Condensate from Production and Field-Processing Operations

ATMOSPHERIC DISTILLATION

First step in refining crude to 100-octane gasoline is atmospheric distillation. Here the crude oil is separated into gas, naphtha, diesel oil, gas oil, and topped crude. The topped crude may either go to vacuum distillation, as shown here, or it may go to one of the four optional processes for handling reduced stocks (as shown at extreme right).

TOPPED CRUDE

DIESEL OIL

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cycle st
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and thus
gasoline
unit.

NAPHTHA

GAS

GAS OIL

INTERMEDIATE PRODUCT PROCESSING

All gas-oil and naphtha fractions must be catalytically converted to higher-octane stocks. The 100-octane-gasoline refinery needs both recycle-gas-oil extraction and catalytic-reformate extraction to boost octane of finished stocks. A supplementary process for making hydrogen may be needed.

CATALYTIC CRACKING

Gas-oil streams from atmospheric distillation, vacuum distillation, and bottoms-processing units are processed in this unit to give a high yield of high-grade gasoline. This is the heart of any refinery geared to produce 100-octane motor fuel. Gas stream from this unit is rich in olefins, butane, and isobutane, and further processing of these compounds leads to more high-octane components.

GAS

CRACKING FRACT.

BURN
O

RECYCLE EXTRACTION

This process may be used to remove aromatic constituents.

FINAL PRODUCT PROCESSING

Several basic units for processing to final product may have to be added to most refineries to make 100-octane motor gasoline. Facilities for more precise fractionation and for pentane and hexane isomerization are being considered in many plants.

LIGHT-ENDS RECOVERY & FRACTIONATION

This can be one integrated plant or several separate gas plants. It consists of absorption, fractionation, and extraction facilities for production of selected streams for further processing. Exact arrangement and operation of units depend on just what subsequent processing steps are chosen.

PROPYLENE

PENTANE

HEXANE

ISOBUTANE

BUTYLENE-AMYLENE

BUTANE

OPTIONAL

FUEL GAS

HIGH-OCTANE GASOLINE PRODUCTS

OCTANE

RES. CLEAR O.N.

O.N. + 3cc. T.E.L.

HIGHER - OCTANI

YDROGEN TREAT DDLE DISTILLATES

s process enables the refiner se some of his cat-cracker re- le stock to make specifica- diesel oil. This reduces some he load on the cat cracker, thus increases the quality of oline stocks produced in this .

VACUUM DISTILLATION

This unit enables the refiner to obtain additional virgin heavy gas oil for cat-cracker operation. Residual from the vacuum column may pass to any one or a combination of the four processes shown at right. Object of each process is to obtain additional gas oil, naphtha, and/or gas for further processing.

HOUDI CAT. CRA

Atmospheric and uals, containing large amounts of processed in this verted gas oil ma or it may be dive furnace oil.

HYDROGEN ENRICHMENT PROCESS

Enough hydrogen is produced in catalytic reforming for most hydrogen-treating needs. However, if H.D.S. is used, this process is needed to produce additional hydrogen.

DEPENTANIZER

REFORMER HYDROGEN PRETREAT

Hydrogen pretreating of cat-reformer feed leads to improved operation and improved product. If coker naphtha and other unsaturated streams are used, the process is a must. It is also highly beneficial for streams high in sulfur, oxygen, or nitrogen content.

STEAM

HYDROGEN

DIESEL OIL

URNING OIL

POLYMERIZATION

Propylene from the light-end recovery unit is polymerized to a high-octane stock in this process. This unit is a must for the 100-octane refinery, because of the comparatively large amounts of propylene produced in cat-cracking operations.

PENTANE

OUTSIDE PENTANES

* BLENDING VALUES WITH CA

POLYMER GASOLINE	CRACKED GASOLINE	
	LIGHT	HEAVY
96	93	90
98.5	99	96

IER - OCTANE MO

VACUUM DISTILLATION

This unit enables the refiner to obtain additional virgin heavy gas oil for cat-cracker operation. Residual from the vacuum column may pass to any one or a combination of the four processes shown at right. Object of each process is to obtain additional gas oil, naphtha, and/or gas for further processing.

HOUDRESID CAT. CRACKING

Atmospheric and vacuum residuals, containing comparatively large amounts of metals, may be processed in this unit. Unconverted gas oil may be recycled, or it may be diverted to product furnace oil.

This process
vert residue
tillates, an
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DEPENTANIZER

REFORMER HYDROGEN PRETREAT

Hydrogen pretreating of cat-reformer feed leads to improved operation and improved product. If coker naphtha and other unsaturated streams are used, the process is a must. It is also highly beneficial for streams high in sulfur, oxygen, or nitrogen content.

CATALYTIC REFORMING

The octane number of straight-run and synthetic naphthas can be upped considerably by catalytic reforming. Straight-chain hydrocarbons are isomerized, and/or converted to naphthenes and aromatics. The cyclization and dehydrogenation lead to elimination of hydrogen which is used for hydrogen treating elsewhere in the plant.

STEAM

DIESEL OIL

HYDROGEN-RICH GAS

YMERIZATION

ne from the light-end re-
unit is polymerized to a
tane stock in this process.
it is a must for the 100-
refinery, because of the
atively large amounts of
ne produced in cat-crack-
rations.

PENTANE

PENTANE ISOMERIZATION

OUTSIDE PENTANES

Isopentane is a prime blending stock for high-octane gasoline. A pentane isomerization unit, which takes its feed from a depentanizer prior to catalytic reforming and from the light-end recovery unit, leads to an increase in both volume and octane number of the finished blend.

Thi
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* BLENDING VALUES WITH CATALYTIC GASOLINES

MER GASOLINE	CRACKED GASOLINE		ISOPENTANES	DIM
	LIGHT	HEAVY		
96	93	90	* 92	
98.5	99	96	*106	

OTOR FUELS

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H.D.S.

ocess may be used to con-sidual feed stocks to dis-, and to remove most of fur at the same time. Ma-f the feed is converted to cker feed stocks, and only ll amount of furnace-oil ns results. The process is pplicable to whole or l crudes.

GAS

COKING

Residuals are converted to naphtha, gas oil, coke, and gas in this process. After a hydrogen pretreat, the coker naphtha makes good feed stock for the catalytic reforming unit. Gas oil may be fed directly to the cat cracker.

DEASPHALTING

This process utilizes propane and butane to extract asphaltic compounds from the lower-carbon-residue fraction of the topped crude. It can be employed to reduce the fraction containing heavy asphalt and metal contaminants to a low percentage of the original crude.

CE OIL

COKE

ASPHALT

GAS

REFORMATE STAB.

REFORMATE EXTRACTION

Reformate from the catalytic reformer contains some low-octane heavy paraffins. In the reformate extraction process, high-octane components are extracted from the heavy paraffin stream and sent to blending operations. The low-octane stock is returned to the cat reformer for conversion to higher octane material. It can also be withdrawn as jet fuel, or thermally reformed.

REFORM. FRACT.

HEXANE ISOMERIZATION

This process, used during World War II for avgas manufacture, is subject to revived interest. The isohexanes fraction is about 20 points higher than that of normal hexane. Clean burning characteristics and better volumetric yields favor hexane isomerization over cyclization and dehydrogenation to benzene.

ALKYLATION

Alkylation provides one of the prime stocks for blending a high-octane fuel. Isobutane, butylene, and amylene feed are made available in the light-end recovery operation. Additional isobutane comes from butane isomerization. Alkylate is looming more important from the standpoints of both octane and fuel sensitivity.

BUTANE ISOMERIZATION

This process is used when additional isobutane is needed for alkylation. The individual refiner may elect to purchase needed isobutane, rather than to isomerize.

TREATER

OUTSIDE BUTANES

ISOHEXANES		ALKYLATE	BUTANE	REFORMATE	
DIMETHYL BUTANE-RICH	METHYL PENTANE-RICH			LIGHT	HEAVY
* 92	* 78	* 94	* 95	80	110
* 104	* 94	* 105	* 104	92	112